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CONTENTS.

Editorial 1327
Central Station and Railway Power House Insurance 1332
Decision Under Recent German-American Patent Agreement 1333
Tax and Rate Value of Public Service Corporations 1333
Drainage Canal Trustees May Finance Chicago Lighting 1333
1200-Volt Connecticut Railway 1333
Jamestown (N. Y.) Voters Decide Not to Purchase Central Station.. 1334
Ohio Independent Telephone Situation 1334
New Tesla Wireless System 1335
Stevens Engineering Society 1335
Electric Service Temporarily Crippled in Winnipeg 1335
Residence Lighting 1337
The Exhaust Steam Turbine for Central Station Work 1337
The Electric Vehicle and the Central Station 1338
Thirty Years of Electrical Development 1339
New York Public Service Commission News 1342
Non-Sparking Synchronous Commutating Machine 1343
Opening of New Physics Laboratory at University of Illinois..... 1343
Current News and Notes 1345
Generating Station of the Home Electric Light & Steam Heating Company at Tyrone, Pa. 1345
Underground Distribution for Small Cities and Towns. By J. Franz. 1348
Refrigeration and Electricity Generating Stations. By Sydney F. Walker 1350
Methods of Drive for Alternators. By J. E. Latta 1352
Protection to Station Apparatus. By Max H. Collbohm..... 1353
Combination Wireless Telegraphy Receiver 1355
A Year's Performance of a Double-Zone Gas Producer 1357
Central-Station Electrical Motor Service. By W. S. Kelley..... 1358
The Prevention and Removal of Boiler Scale.—VII. By W. H. Wakeman 1362
Letters on Practical Subjects 1364
Questions and Answers 1368
Coal Consumption in High-Speed Engine Stations..... 1369
Analysis of Discontinuances of Electric Service..... 1369
Cost of Railway Power in Chicago..... 1369
Special Street-Lighting Installations in Chicago..... 1370
Increase in Chicago Central-Station Business Analyzed..... 1370
An Inexpensive Electric Equipment for Dumb-Waiters. By S. H. Sharpsteen 1371
Factory Lighting 1372
LETTER TO THE EDITOR:
Central-Station Boiler. By G. F. Fenno 1373
Digest of Current Electrical Literature..... 1374

GETTING AFTER THE "ELECTRIC TRUST."

Reports from Washington indicate that Uncle Sam, after having taken a fall out of several prominent trusts, is arming for another fray and proposes to see what is doing in electrical manufacturing and in the development of water-powers for electrical generation, in both of which fields a trust has been alleged to exist. Now, the facts as to electrical manufacturing are, broadly speaking, quite well known, the essential thing being that a large part of the manufacture of heavy electric machinery and of electric lamps is in the hands of several big concerns having more or less friendly relations. Whether the nature of these affiliations constitute a trust in the legal sense of the word is quite another matter, for certainly the relation of the larger to the smaller concerns in the electrical manufacturing business is radically different from any industrial relations the trust suits have heretofore brought to light. Such monopoly as has been secured is largely the direct effect of Uncle Sam's own patent system, which he can hardly be disposed to regard as a proper subject for the action of the anti-trust law. This part of the investigation can at all events go on in a perfectly proper and regular manner, and when the facts are brought to the surface, the rights of the case will be plainly enough seen. With respect to the alleged water-power trust, reputed to be backed by the alleged electric trust, the case is, however, quite different.

There is absolutely no doubt that within the last 10 years business men the world over have awakened to the value of water-powers and to their desirability as investments. Consequently, many of them have been picked up and developed for electric transmission to the great benefit of the territory served, but we do not believe that the people who are howling most loudly about the water-power trust understand what are the real relations between the owners of hydraulic properties and the electric manufacturing companies. The latter are naturally anxious to sell all of the machinery possible, and each of them is anxious also to add to the list of plants regularly using its particular type of apparatus. In such cases a customer once secured almost always remains a customer for enlargements and replacements, on account of the very natural tendency to install one kind of apparatus rather than several kinds that, in theory at least, might introduce complexities in operation and require an appropriate variety of spare parts. Hence, when a hydroelectric proposition is in the air, the manufacturing companies hustle to supply the machinery. Whether the relations between different companies determine beforehand who is to have any particular job need not here be discussed; but we have yet to hear of any case in which a person who wanted to develop a hydraulic proposition, and had the funds at his disposal to do so, had the slightest difficulty in buying on advantageous terms any kind of equipment which he chose to order. Whatever the relations between the big manufacturing companies may ultimately be, it is quite certain

that their representatives hustle vigorously after business and that an astute buyer can do some very keen trading between them.

The reputed connection between the manufacturers and the so-called water-power trust arises largely from the fact that a good many people who own water-powers go to the manufacturing companies or to their immediate backers for aid in financing their propositions, and having received such aid, very naturally fall into line as regular customers and are regarded as being more or less affiliated with those who supply them. So far no objection could properly be made to such a relation, which could only become obnoxious in case a man who attempted to finance a hydroelectric scheme should find his attempts blocked in all directions except that leading to certain manufacturers. This thing is alleged to have occurred, and should there be truth in the allegation, it is time to investigate, not so much the water-power trust, as what one may call the banking trust that, through a community of interests, may attempt to control enterprises of all sorts over a wide territory.

We do not fancy, however, that Uncle Sam cares to investigate this phase of the matter, which might lead to unpleasant revelations. There is, however, one phase of the reputed water-power combination which cannot fairly be considered in the light of a trust at all, although it tends to monopoly, and that is the aggregation of hydroelectric plants in contiguous territory into a single physical system. This tends distinctly toward the conservation of our natural resources, since it is well known to engineers that a group of plants consolidated into a network can produce power more cheaply and more reliably when acting together than when acting independently. The existence of great power networks may tend to the monopoly of the power business in any given territory, which monopoly is entirely susceptible of regulation by the proper authorities; but such a monopoly is economically advantageous in making the most of the power available and must be given this credit in any investigation that may be made. There has undoubtedly been much buying of water-powers for investment, and it is fairly of record that a considerable number of powers have been acquired by those having a community of interest with electrical manufacturing companies. So far, however, as has yet appeared, this action represents a tendency toward a particular class of desired investments rather than a concerted attempt to grasp the hydraulic resources of the country. If there is any actual effort of the latter sort, it must be looked for among the powers higher up, which, in virtue of no definite agreement perhaps, but yet with community of purpose and action, tend to control any and all operations which require large aggregations of capital.

Gasoline Competition.

Some central-station managers seem much at a loss to know why they have so much difficulty in meeting gasoline competition, and a brief consideration of conditions frequently found in gasoline-infested towns may throw some light on the reasons for the anomalous popularity which gasoline lighting occasionally meets. A recent visit about 9:30 p. m. to the business district of a prosperous town of 4000 population in the Central States showed at that hour seven establishments fully lighted up. Every one of these had a private gasoline plant. Not a tungsten lamp was in sight. A visit to other towns of the kind, where gasoline lamps have not yet been run out by the tungsten lamp, usually reveals a similar condition of affairs, namely, that the most desirable long-hour customers are the ones which the company has lost through gasoline. The primary reason for this is often to be found in a faulty system of rates, which makes no distinction between the consumer who burns his lamps an average of one hour per night and the one who burns his lamps an average of four hours per night. As the long-hour users' bills are high on such a schedule, he is much more easily tempted by the wiles of the gasoline plant salesman. Here, then, is one of the fundamental troubles which should be righted if a company expects and desires to hold its most valuable class of lighting business. On top of this oftentimes the electrical service is poor and unreliable and the central station has made no effort to give the consumer more light for his money by introducing tungsten lamps in efficient reflectors. Even if all the foregoing requirements have been complied with, gasoline plant salesmen have a good show in a town if the company discriminates in its rates between customers or fails to meet its customers in an open, courteous, fair-minded way.

After the novelty wears off no owner of a gasoline lighting plant operates it for the supreme enjoyment there is in it. The handling of gasoline is dangerous, the operation of the plant is dangerous, the maintenance of mantles is not pleasant, and with good electric service, tungsten lamps, proper treatment by the company, and above all, a system of rates which automatically adjusts itself to give a low rate to long-hour users, gasoline competition has very little to stand on. It is doubtless true that private gasoline plants should be restricted by legislation as a menace to the surrounding buildings, and should be subject to higher insurance rates, instead of being ignored by insurance companies, as is sometimes the case. Nevertheless, electric lighting men, on account of their peculiar competitive position, cannot, with favor in the eyes of the public, take too active a part in the bringing about of adverse legislation. They can, however, demand better insurance rates for electrically lighted properties than for those near a gasoline plant. The main weapons with which this competition is to be met, however, are a proper business policy, good service and high-efficiency lamps. With these it is only a question of time when the gasoline plants will be run out of any town.

Magnetic Fields Associated with Sun-Spots.

We know from laboratory experiments, as well as from electromagnetic theory, that the motion of electrified particles is equivalent, in its magnetic effect, to an electric current. Consequently, whenever we have motion in a gas, we may expect magnetic manifestations, if the gaseous particles are electrified. At ordinary velocities and electrifications of gases, however, such magnetic effects are very small. There is strong reason for believing that a minute magnetic field component on the surface of our earth is produced by vertical currents in our atmosphere, these up and down currents of air carrying electrified particles. At the sun, everything is on a large scale. Temperatures, velocities, gravitations and sizes are big. Sun spots are either storms in the solar atmosphere, or are associated with such storms, judging from the shapes of the local solar clouds, their rapid movements, and their spectrum indi-

cations. Moreover, we have strong reason to suspect that solar material emanations are electrified. Consequently, with large masses of electrified particles moving at velocities that seem uncanny to our terrestrial minds, it is reasonable to expect that goodly and intense magnetic fields may be generated at these spots. A note by Mr. George E. Hale, in a recent number of the publications of the Astronomical Society of the Pacific, contains a number of interesting statements concerning magnetic fields in sun-spots, as deduced from spectrum analysis of their light. Magnetic flux-densities ranging from 2900 gausses to 4500 gausses are alluded to as maximum inferred values. Such magnetic fields are of ordinary dynamo air-gap intensity, or even of transformer-core effective intensity. If these figures are reliable, it would not be necessary to provide a magnetic field-magnet for a unipolar generator situated near a sun-spot. A rotation of the naked armature at the regular speed would amply suffice to generate the usual voltage. Nevertheless, it is probably better to stay here and keep our field-magnets in service.

ALTERNATING-CURRENT TRANSMISSION LINE CHARTS.

Frequent computations of, or designs for, the electrical working of alternating-current transmission lines inevitably tend to incline the engineer toward artifices for simplifying the process, and for making it more definite and swift. There are various stages of line-transmission computation. In the simplest case, nothing is considered but the ohmic drop of potential. In the second stage, inductive reactance is taken into account, in addition to ohmic resistance. In a third stage, applicable to fairly long lines, capacity reactance is included, by assuming all the line capacity collected, either into one middle condenser or into two equal terminal condensers. Finally, in a fourth stage, ordinarily applicable only to the longest lines, the effects of distributed resistance, inductance and capacity are included. For present purposes, however, only the second-stage computations, involving resistance and inductive reactance, are ordinarily considered. The *Revue d'Électricité* recently contained an article by Prof. André Blondel, which has been abstracted in the Digest, on the above type of computation, and on devices for reducing the work to the level of careful inspection of specially prepared charts. The article contains a carefully prepared chart of line impedance-drops, for different sizes of copper wire, at given interaxial distance, at standard frequency. By linking this chart with a second diagram on tracing paper, the conditions of the line can be read off at the junctions of the curves intersecting between the two.

Two cases are considered, namely, first for constant pressure at the delivery end, and second, for constant pressure at the generator end. The construction of the tracing-paper diagram differs in these two cases, but the essential principles are alike in both, and involve vector addition and subtraction. The method described will doubtless be found useful when preparing a large series of line computations. A somewhat similar device by Mr. F. G. Baum was described some seven years ago in our columns. That device was constructed in cardboard with a pivoted celluloid protractor. In the Baum device the line-drop is expressed in percentage, both for resistance and reactance. It corresponds, under that restriction, to the first case of the Blondel discussion. Conditions differ so much in detail between the engineering practice in different countries, or even in different parts of one and the same country, that it is impracticable to work out a device that will meet all demands. Tower line construction, with aluminum cables, at 25 cycles per second, calls for a different set of charts from pole-line construction, with copper wires, at 60 cycles per second. Nevertheless, there is much value in such a device for one set of conditions alone, because it illustrates the conditions of the general problem in a simple mechanical manner, and it gives a swift practical solution for one set of conditions that is very helpful in forming an approximate idea of the solution under variously modified conditions.

GERMAN STANDARD REGULATIONS FOR ELECTRICAL MACHINERY.

Corresponding to the Standards Committee of the American Institute of Electrical Engineers in this country, there are certain committees of the Verband Deutscher Elektrotechniker in Germany which formulate rules for the classification of rating and testing of electrical machinery. These rules were first reported to, and adopted by, the Verband in 1901, and have since been revised in 1903, 1905, 1907 and 1909. It would seem as though biennial revisions of these rules were incorporated, by tacit agreement, in their text. The salient features of the German standardization rules, as they stood in 1908, appeared in these columns in the issue of June 13, 1908, in comparison with similar standardization rules of England, France and America. Various differences appeared between these schedules, but salient among them was the rule for testing the dielectric strength of the insulation. The German rule called for an application of the testing voltage for 30 minutes, whereas the French rule called for a two-minute application and the American rule called for a one-minute application. In the revised set of German rules as amended this year this regulation has been changed. As it now stands, it calls for a one-minute application of the testing voltage, which corresponds with the American requirement. As regards the magnitude of the testing voltage, there is still some difference in detail between the German and American rules, but the amendment has brought them much nearer together.

If this process of mutual convergence in national standardization rules continues unchecked, the International Electrotechnical Commission will have an easy task. Allowing sufficient time, as the commission seems generously inclined to do, it may only have to take the final standardization rules of any one country, print an international title, and issue them to all in their proper and appropriate tongue. It is, of course, natural that reasonable men, working on national committees, should aim to eliminate from their local rules the needless and the complex, and should seek to incorporate the good and simple provisions of neighboring national rules, so that it is logical to expect that this process of mutual convergence will continue to be manifested.

Considered reciprocally, there are certain provisions in the new German standardization rules that our American standards committee would do well to follow. First among these is a division of electrical machinery into the continuous and discontinuous-service types. At present, only the continuous-service type is standardized with us. All other types are

treated, from the standpoint of our rules, as exceptions and as laws unto themselves. In both England and France the rules provide explicitly both for continuous and intermittent-service machinery, the latter being defined and subclassified more or less; while in the German rules there are three types recognized, namely, continuous, short-period intermittent, and long-period intermittent. Separate consideration is given to machines of these three types throughout the rules. It would seem that either two types, or three types, of service should be explicitly recognized in our rules. There are so many intermittently working machines that it is almost as incongruous to treat them exceptionally as was the guide-book which mentioned that at a certain well-known health resort 39 out the last preceding 40 winters had been climatically exceptional.

Another point to which the attention of our standards committee might well be drawn is the diversity of German temperature elevations allowed in machines of different insulation construction. In insulated rotating cotton-covered windings they allow an elevation of 50 deg. C.; in paper-covered windings, 60 deg. C., and in mica or asbestos-covered windings, 80 deg. C. In our rules 50 deg. C. is the only temperature elevation specifically mentioned for all classes of insulation construction, although a modest and unobtrusive paragraph says that higher elevations are permissible with special heat-resisting insulations, a truism which is so true as to be meaningless in the absence of quantitative specification. Meanwhile, the rules are subjected to disparagement in the minds of some practical central-station operators, who know by experience that their machines can carry considerably increased temperature elevations without danger. It would be much more direct and effective to specify different elevations of temperature for different specific types of insulation construction. If the above two modifications were made in our own rules, and in the directions already followed by other countries, a still closer approximation would be reached toward mutual international agreement, and the task before the International Electrotechnical Commission would be thereby still further simplified. This suggestion is intended as an incentive to, and not as a criticism upon, the work of our standards committee, which has, in general, been of the greatest and most valued service to the electrical industry.

The Heating of Field-Magnet Coils.

The heating of field-magnet coils in a dynamo is well known to be caused by the joulean action of the magnetizing current, the power so expended being I^2R watts. The cooling of such coils is by no means so simple a matter. It depends upon the facilities possessed for dissipation of heat, by conduction, convection and radiation The temperature elevation of the coils under steady running conditions is always such that the joulean development of heat is exactly equal to the total dissipation of heat by the above three causes combined. Strictly speaking, therefore, it is impossible to predict, or even properly to apprehend, the final temperature rise on the field coils of a dynamo, under given working conditions, unless the amounts of heat dissipated in each of these three ways can be ascertained. As a matter of fact, the subject of heat dissipation is so complex that we have but very imperfect knowledge of it as yet, and, consequently, we are unable to predict such temperature elevations with any attempt at precision; but by many observations conducted on a large number of different machines, we have been able to secure some useful empirical formulas that are not very misleading if carefully watched.

Some measurements have recently been made in the case of one particular 6½-hp motor. These measurements have recently been published in the London *Electrician* in an article by Mr. G. Trevor Williams. The motor was placed in an air-tight cast-iron case, which could be exhausted by an air pump. The motor could either be kept stationary with its field magnets excited, or it could be driven by external power applied to its shaft, through an air-tight stuffing-box. The armature was not excited in any of the tests. The power supplied to the field magnets of the motor was measured electrically, and was adjusted in the different tests until the temperature rise was steady. After reducing the results to the same final temperature elevation, it was estimated that very nearly half of the power dissipated from the field coils under running conditions in air was attributable to convection loss, and the remaining half to conduction and radiation combined. These results indicate, in a general way, how much of the cooling of magnet coils may be attributable to convection. They cannot, however, be expected to determine the true state of affairs under the conditions of practical operation, because, when the armature is heated by its load-current, the distributions of heat, and of heat dissipation, are largely altered, and are altered in a very complicated manner. Nevertheless, these results, piecemeal as they are with respect to operating conditions, and as affecting only one particular motor, are yet the only ones we have thus far seen published on this difficult subject. There is a very large field open to experimental and mathematical investigation on the dissipation of heat from dynamo machines. At present, it is only roughly covered with a few empirical formulas. Nevertheless, with the increasing sizes of dynamos, the question of cooling is of continually rising importance.

Atomic Theories of Matter and of Electricity.

The meeting of the British Association for the Advancement of Science last month, at Winnipeg, is particularly notable for the addresses of the president, Prof. J. J. Thomson, and of the Mathematical and Physical Section president, Prof. E. Rutherford, both of which dealt with atomic theory in a very definite way. The addresses of these two men, who have identified their work so closely with the modern theories of matter and of electricity, are of great interest, and sum up to date the extent of our scientific knowledge on the nature of matter and of electricity.

It has been supposed by some that the discoveries of radioactivity have dismantled the atomic theory; but it is pointed out by Rutherford that, on the contrary, the results of research with radium and its congeners have greatly strengthened this theory in general. They merely indicate that at least some atoms are impermanent structures, and that the proposition as to the indefinite persistence of all atoms in the known universe must now be no longer postulated. We may suppose, therefore, that at least some atoms are born, live and die in a manner roughly analogous to the biological processes of our own existence. The most recent experiments described indicate that atoms may, in a certain sense, be counted. Ordinary non-

electrified molecules can only be rendered evident to the senses when present in vast numbers or complex aggregates. To take an example offered, the smallest quantity of the substance *neon* which can be detected spectroscopically contains about 10 million million neon molecules, or about 7000 times the number of human beings on the earth. On the other hand, it is stated that we can render evident the passage of single electrified helium atoms into a receptacle arranged for their reception, and that they can be counted as they enter.

Many attempts have been made in the past to estimate the number of molecules in a cubic centimeter of gas under normal pressure and temperature. A number of the more recent estimates are collected and compared, taken from different sources and by different methods. It is known that, by Avogadro's law, all gases at like pressure and temperature have the same number of molecules per cubic centimeter, so that what is true of one gas applies to any gas. This number is now regarded as being known within a small percentage. A cubic centimeter is a large volume to discuss in this relation, because the gaseous molecules must be so excessively minute. The unit of linear measure used by microscopists is the micron, or the millionth of a meter. A cubic micron is a volume that is about the limit of visibility in the microscope. Some bacteria have such a volume, or occupy such dimensions, approximately. The number of molecules in a cubic micron, according to Rutherford's estimate, is 27,700,000, or, let us say, about the number of individuals in the population of England at the beginning of this century. The members of this population in the cubic micron are to be considered as flying and oscillating to and fro at great speeds, the volume that they jointly occupy in their own persons being very small compared with the cubic micron that they inhabit.

Not only has the theory of radio-activity done much thus far to place the pre-existing atomic theory on a firm basis of counting and reckoning, but it has also opened up an ultra-atomic world. Infinitesimal as single molecules must evidently be to squeeze England's population into a cubic micron without seriously hindering its whizzing flights, a molecule must be a huge thing compared with a corpuscle. The properties of corpuscles are now engaging the attention of numerous physicists. The destruction of the individuality of the atom by the new radium-born theory that atoms are composite and contain many corpuscles, has created in exchange an atomic theory of electricity. According to recent observations, every corpuscle is endowed with an indentically similar electric charge. It is now supposed that electric charges are all multiples of this corpuscular unit, and that it may be impossible to have a fractional charge left over after all such unit quantities are counted. In this sense, electricity is supposed to be made up of very small unit quantities, each corpuscular in its nature. The estimated magnitude of this unit atom of electricity is 4.65×10^{-10} c.g.s. electrostatic unit of quantity. It is supposed that the structure of the atom is held together by forces that are at least mainly electrical in character. Roughly speaking, then, the corpuscles are cemented into the atomic planetary system by electric forces which are perhaps enormously powerful; so that if an atom disrupts, an explosion occurs with loss of energy, a liberation of particles, and the formation of new elementary substance.

NON-INDUCTIVE WATER-COOLED STANDARD RESISTANCES.

The last number of the *Journal* of the Institution of Electrical Engineers of Great Britain contains a communication by Messrs. Patterson and Raynor, of the British National Physical Laboratory, on the construction of certain standard working resistances. These resistances are required to carry alternating currents up to 2500 amp with a rated drop of pressure of 2 volts. The largest capacity of these standards has, therefore, to dissipate 5 kw, which renders water-cooling desirable. Water-cooled resistances are not new, but these new designs are interesting from several standpoints. Each resistance consists of a short vertical length of seamless manganin tube, welded at its ends into heavy, hollow copper end pieces, which serve as the current-terminals and also as nozzles for the internal circulation of the water supply for cooling the manganin tubes under load. It is computed that the inductance of these standard resistances is limited to a few centimeters, or milli-microhenrys. The largest capacity (2500 amp) has a computed inductance of only 3 cm. The time-constants of these resistances are thus reduced to a few tenths of a microsecond. The current density at which the tubes are worked is in the neighborhood of 16,000 amp per square inch.

100,000-CYCLE ALTERNATORS.

An interesting paper, read at the Frontenac convention of the American Institute of Electrical Engineers, by Mr. E. F. W. Alexanderson, dealt with alternators for a frequency of 100,000 cycles per second. Up to the present time only few small machines, of 1 kw or 2 kw capacity each, have been constructed for this frequency, although a machine of 35 kw estimated capacity is stated to be in course of construction. Heretofore, such frequencies as 100,000 cycles per second have only been obtainable from the excitation of condensers, and the steady generation of such a frequency from rotative machinery forms a distinct step in the advance of alternating-current apparatus, although at this time wireless telegraphy and telephony are the only arts that demand such frequencies. Some remarkable properties are likely to be presented in circuits operated at a frequency of 100,000 cycles per second. In the first place, the skin effect in copper is sufficiently marked at such a frequency as to make the ordinary copper wire table of very little use, and to upset the application of the ordinary form of Ohm's law to conductors. Secondly, the effect of inductance is greatly enhanced, so that an incandescent lamp with a couple of turns in its filament is likely to present an impedance distinctly in excess of its resistance; the candle-power of such a lamp might thus be detectably less at a given terminal voltage than when supplied with direct current or ordinary low-frequency alternating current. Finally, small condenser capacities in the circuit would be likely to produce marked changes in the current supplied at this frequency. The mechanical problem of maintaining a rotative speed of 20,000 revolutions per minute itself calls for special considerations in design. The paper points out that there are two critical passing speeds at which shaft vibration is set up, due to the vibration of the rotating system as a loaded string. Fortunately and praiseworthily, the paper is almost entirely written in the metric system, so that the reasoning and numerical checks upon this interesting phenomenon are easy to follow. It is to be hoped and expected that these machines will be of great value in the wireless service for which they were designed.

Central-Station and Railway Power-House Insurance.

The recent renewal of controversy between electric light and traction companies and the old-line stock insurance companies, and the efforts being made by the insurance committees of the electrical and traction associations to secure better treatment, have reached a stage that menaces the business of the stock companies so far as relates to electrical risks. Mr. Henry N. Staats, who, as the insurance expert, has been at work in behalf of the associations for the past five years, makes the following explanation of the present condition. For years, he states, the insurance committees of these associations have been endeavoring to secure better treatment and more uniformity in methods of inspection and rates. In this endeavor there have been organized two insurance companies under the laws of Ohio called the American Railway Insurance Company, the purpose of which is to write risks upon traction properties, and the Electrical Insurance Company, the purpose of which is to write risks upon central stations and light and power properties. Each of these companies is capitalized at $200,000, with the privilege of increasing its capitalization as needed by the growth of its business. These are not mutual companies, but their stock is subscribed for by traction and lighting interests.

It was not the plan, according to Mr. Staats, to cut into the business of the old-line companies, but it was believed that by having in the field insurance companies which were identified with these specific industries better service could be secured. After the organization of these companies a plan of co-operation was drawn up, which was submitted for approval to the governing committees of the old-line stock companies. This plan contemplated the formation of a central inspection and survey bureau for the properties of electric railway and lighting companies. It provided that this bureau should be located in Cleveland as a central point, and recommended co-operation with the regular insurance agents as long as this would tend to promote the interests of the assured. It recommended eliminating the insurance broker, and suggested that the old-line companies should co-operate with the two newly organized electric insurance companies. It also provided that these companies should be the medium for negotiating the business for electric properties, the one for traction and the other for lighting properties; that all railway and lighting business should be distributed from the central bureau, and that all plans, specifications, inspections, etc., should be made under the supervision of this bureau. The old-line companies, in connection with the electric insurance companies, were to contribute to the support of this bureau, their contributions to be based on the gross premiums paid to them by electric properties. Twenty-five per cent of the total amount of insurance on all these properties was to be assumed by the Railway Insurance Company and the Electric Insurance Company.

The plan also provided for the co-operation of the National Electric Light Association, the Association of Edison Illuminating Companies, the American Street and Interurban Railway Association and the Central Electric Railway Association with the old-line companies, by each association employing one of its members as an insurance expert, through whom all complaints were to be made, this expert to confer direct with the board of arbitration. It was furthermore provided that the board of arbitration should be composed of two members of the Eastern Union and two members of the Western Union of the old-line companies, together with Mr. Staats, representing the electric companies, and that the American Railway Insurance Company and the Electric Insurance Company would conduct their business at actual cost, and pay no commissions.

Mr. Staats says that after many conferences with, and at the invitation of, the Western Union Tariff Association, this plan was submitted to the governing committees of the Eastern and Western Unions on Oct. 12. Steps were taken at that time for the appointment of committees for bringing about co-operation. After that date, however, representatives of the Board of Underwriters' Associations met in New York, to which meeting no representative of either of the newly organized electrical insurance companies was invited, and, after considerable discussion, the Central Traction and Lighting Bureau, which was referred to in our issue of Nov. 18, was formed. It is Mr. Staats' opinion that this action was taken by the old-line stock companies for the purpose of forestalling the formation of a similar bureau under the plan submitted by the insurance companies identified with the electrical business, and for the purpose of cutting these companies out of competition.

Mr. Staats also says that since the agitation of the insurance question by the committees of the national electric and traction associations the old-line-companies have reduced rates very materially. In some instances, particularly in localities closely identified with the movement to organize the new companies and to establish a bureau, risks have been written at rates that were below the possibility of profit. He cites as an instance that the Cleveland Railway Company has been given a 15-cent rate upon all of its protected properties. Mr. Henry J. Davies, chairman of the insurance committee of the American Street and Interurban Railway Association, is secretary and treasurer of the Cleveland Railway Company, and has been active in his efforts to better the insurance conditions of traction companies.

It is the present purpose of the insurance committees of the electrical associations, by which Mr. Staats is employed as expert, to continue the struggle to secure the co-operation of the old-line stock companies with the new companies, and to continue the effort to have some voice in the matter of inspection and regulation of rates. Under the plan of co-operation proposed this was contemplated; under the central bureau which has been established by the insurance associations the electrical associations are without representation. According to Mr. Staats, it is feared that if the matter is entirely kept in the hands of the insurance companies the present lowering of rates will not be long maintained.

Definition of Annual Horse-Power.

Though the Canadian Niagara Power Company won the interesting action, recently referred to in these columns, covering the judicial interpretation of what constitutes an annual horse-power, the Niagara Falls Park Commission has applied for a rehearing. Mr. Justice Riddell gave a lengthy judgment in dismissing the plaintiff's claim for $15,217.97 alleged as rental due for excess power generated at the company's power house during the years 1905, 1906, 1907 and 1908, but the Attorney-General, acting on behalf of the commission, has applied to have the action reopened on the ground that the judge held that rate multiplied by time was to govern, and that the actual power used was sold and not the rate.

The plaintiff commission asks that it be allowed to give evidence that in the case of electricity a rate can be sold, namely, a rate of doing work (horse-power); that a substantial portion of the sales of the defendant power company are of such rate that sales or disposals of electricity may and do exceed the maximum horse-power generated; and that evidence may be adduced as to the number of horse-power contained in the sales by the defendants.

The plaintiffs file an affidavit by Frederick A. Gaby to the effect that it is common commercial practice to consider that the rate of work established at any time in a period of a contract should be the basis of computation, either for the future portion of such period, or for the future and the past; and in such sales the permanence or continued use of such rate is not material to the computation of the price charged therefor. The engineer says that all sales of the Hydroelectric Power Commission are based on the highest rate of work established in a certain period—that is, each month payment is made for the entire month for such highest rate of work, or maximum horse-power, known as the peak load, even though such highest rate should be demonstrated and established only on the last day of such month.

If the case is allowed to be reopened argument will probably proceed on Dec. 13. The indications are that the point in dispute will go to the Imperial Privy Council in England.

Decision Under Recent German-American Patent Agreement.

The German Imperial Supreme Court rendered a decision on Nov. 26 in which it interpreted a recent patent agreement between Germany and the United States in favor of an American company, which has a branch office in Berlin.

This branch office secured letters-patent under the German law on an invention, but failed to place the invention on the market within three years, the time specified by the German statute for so doing. Thereupon a German brought suit to vacate the patent rights, and the Patent Office decided in his favor. The American firm, however, took an appeal to the Imperial Supreme Court, and while awaiting a decision transferred the patent rights to its parent company in the United States.

The decision of the court declared that the Patent Office had wrongfully revoked the letters of patent and must renew them, as the German-American agreement guaranteed reciprocal treatment of patents.

The German-American patent agreement was signed at Washington, Feb. 23 of this year, and having been duly ratified by the House of Representatives and the German Reichstag, was promulgated simultaneously Aug. 1 by President Taft and the Kaiser. It became effective immediately.

By its terms American inventors were relieved from the German restrictions which declared patents forfeited if not actually worked in Germany within three years after letters of patent were granted, it being declared sufficient in order to protect patents in both countries that the invention involved be manufactured in either country.

Tax and Rate Value of Public Service Corporations.

A communication from Mr. B. H. Meyer, chairman of the Railroad Commission of Wisconsin, treating of the relation of the tax and rate value of public-service corporations, was incorporated in the report of the committee on railroad taxes and plans for ascertaining the fair valuation of railroad property presented at the meeting of the National Association of Railway Commissioners, in Washington, D. C., on Nov. 16 to 19. The communication is as follows:

"I am free to admit that the identity of what, for the sake of brevity, I shall designate as the 'tax value,' on the one hand, and the 'rate value' on the other is an ideal condition toward which we should move with the greatest possible speed. I hope the time will come in Wisconsin when the value placed upon a utility plant for rate-making purposes will be exactly the value upon which it is taxed, and vice versa. It is impossible of accomplishment to-day. To make the two values identical to-day would be a gross injustice and inequality in many, if not in most, cases.

"As I understand it the taxing authorities endeavor to see to it that all property is made to stand upon a footing of equality in the payment of taxes. The constitutional requirements of equality apply to all dollars irrespective of their owners, and a dollar in a utility plant should bear the same burden that is borne by a dollar in a farm or city lot or factory and all other forms of property, ignoring for the present controversial questions which publicists in taxation have raised regarding the doctrine of equality. This means that the tax value is a commercial value. Commercial value depends primarily upon earning capacity. A utility plant is worth what it can earn. What it can earn and does earn is dependent upon the rate which it charges. To use the earning value of a plant as a basis for determining the rate which creates that value is to attempt to measure a thing by itself. Commercial value, and therefore tax value, being a mere reflex of the rate, can be no guide whatsoever in determining the reasonableness of a rate. As long as the tax value is the commercial value under existing conditions it is obvious that such tax value cannot be the value for rates, or at least that it is not necessarily the value for rates.

"It follows that any discrepancy under these conditions between tax value and rate value is not necessarily injustice. In fact, justice may require just this discrepancy. If the taxing authorities, because of their inability to ascertain the exact commercial value of all forms of property, should, for instance, assess farms or city property at 80 per cent of their respective values, the property of public-utility plants should stand upon the assessment roll at 80 per cent of their value. Because of the publicity and other features attendant upon the conduct of the utility business, it is generally true that the value of the utility property can be more readily ascertained and more generally known than the value of numerous other forms of private property. To assess a utility property at 100 cents on the dollar and industrial or farming property at 70 cents or 80 cents on the dollar would be unjust and unlawful. A commission charged with the duty of prescribing just and reasonable rates could, therefore, not take the tax value as a basis for determining rates."

Drainage Canal Trustees May Finance Chicago Street Lighting.

At a meeting of the Chicago City Council, on Nov. 22, the finance committee was instructed to negotiate with the Sanitary District trustees for the lighting of the entire city, or any part of it, by electricity furnished from the hydroelectric power plant on the Drainage Canal at Lockport, Ill. It will require about $2,500,000 to provide the 17,000 additional street arc lamps, wires and other equipment required to light Chicago properly, and also to provide for changing over from the municipal system now largely in use, by which comparatively old plants supply electricity to open-arc series lamps. These older stations are motor-driven by electric energy furnished by the Sanitary District, but if a comprehensive plan is adopted they will be abandoned in favor of alternating-current transformer substations and alternating-curent, 450-watt lamps, using the Sanitary District energy without the imposition of moving machinery. It is believed that the Sanitary District trustees think that they can finance this proposition, and if they are correct in that assumption, the city authorities will no doubt be pleased to give the matter careful consideration. The trustees will be asked to put their suggestion in the shape of a formal proposition after conference with the finance committee of the City Council, and the matter will then come up for action.

Twelve-Hundred-Volt Connecticut Railway.

The first electric railway in the far East to choose the 1200-volt, direct-current system is the Shore Line Electric Railway, running from Ivoryton to New Haven through Saybrook and Guilford, approximately 52 miles in length. After a careful investigation of the relative merits of both the 600-volt, the 1200-volt direct-current and the single-phase systems, the 1200-volt system was adopted as presenting the advantages of demonstrating reliability, saving in construction cost and in operating expense.

The Shore Line Railway is being constructed and equipped in accordance with the most modern railway practice. A power station is located on the Connecticut River near Saybrook and will contain two 1500-kw, 25-cycle, 11,000-volt, three-phase Curtis turbo-generators with provisions for two additional units. Power will be transmitted three-phase to two stations—one located in the car house at Saybrook and the other at Guilford—each of which will contain three 200-kw, 600/1200-volt rotary converters. Two machines will be oper-

ated in series to supply energy at 1200 volts. The third unit will be used as a spare, the switchboard being so arranged that any two of the three units may be operated together in any relation.

Twelve cars will be operated, each equipped with four General Electric 60-hp, 600/1200 railway motors and Sprague-General Electric control. This equipment is arranged to operate on both 600 volts and 1200 volts. The cars will be provided with straight air brakes with 1200-volt air compressors. The entire equipment of the road will be furnished by the General Electric Company.

It is expected that the road will be in operation the early part of next year. Although 11 roads have adopted the 1200-volt system, the novel methods of construction in this instance will cause the operation of this road to be watched with much interest by railroad operators. As a very high-class service will be maintained and the reliability of service is considered of primary importance, the selection of the 1200-volt, direct-current system indicates the growing favor with which this system is being looked upon as best meeting the requirements of interurban service.

Jamestown (N. Y.) Voters Decide Not to Purchase Central Station.

At a special election held on Nov. 20 the taxpayers of Jamestown, N. Y., rejected the proposition that the city be bonded for $120,000 to provide funds to purchase the plant of the Jamestown Lighting & Power Company and combine it with the existing municipal electric-light plant. Out of about 7000 qualified taxpayers on the assessment roll, only 1211 voted. Of this number, 565 were in favor of the proposition and 646 opposed, making a majority of 81 against the proposed purchase. The election was held in the City Hall, and while the workingmen were in favor of the proposal, the heavier taxpayers were against it, and mustered sufficient votes to defeat the measure. About 100 women voted.

Possibly, if the proposed proposition had been submitted at a general election, it would have been carried. The business men of the city appear generally to have been indifferent to the result, whichever way it turned. The central-station company had previously expressed its willingness to accept $90,000 for its property, the remaining $30,000 to be applied to extensions and improvements necessary to combine the company's service with that of the municipal plant.

Winnipeg Electric Railway Case.

The case of the city corporation against the Winnipeg Electric Railway Company, which has been pending since 1906, was concluded on Nov. 19. It is not expected that judgment will be given for some time, as a great mass of evidence has been taken and a formidable array of arguments presented from counsel for both parties.

The case is an important one to the railway company on account of the claims made by the city. The corporation alleges that the company has failed to keep the conditions of the by-law under which the street railway should be operated, that it brought in power from outside sources contrary to the conditions of the by-law giving the company its franchise, and that it had erected poles and wires in the city without the consent of the municipality, and that in consequence of these acts the company had forfeited its right to do business under its franchise and is a trespasser in the city. The corporation, therefore, sought an injunction to restrain the company from bringing in power from its generating station at Lac du Bonnet, 50 miles east of the city.

Back in 1906 the old Winnipeg Street Railway Company acquired control of the Winnipeg, Selkirk & Lake Winnipeg Railway, as well as the Winnipeg General Power Company, and an amalgamation was effected under the name of the Winnipeg Electric Railway Company. The Winnipeg General Power Company was at that time in possession of a water-power partially developed at Lac du Bonnet, some 50 miles distant from the city, and the local company upon acquisition of the Winnipeg Power Company proceeded with the hydroelectric development and transmitted the power into its substation within the city in order to care for its rapidly growing business and to replace its steam-driven plant. The city corporation has since that period embarked upon a municipal hydroelectric development on the same river, and it has brought the action against the Winnipeg Electric Railway Company seeking an injunction restraining the company from bringing in the hydroelectric power on the ground that this action on the part of the company was contrary to the provisions of the franchise granted, which provided that the company's generating plant should at all times be situated within the limits of the city, thus putting the corporation in a position to collect taxes on the assessed value of the plant and machinery.

The defendant company claimed that by amalgamation they acquired all the rights, properties and franchises of the original company to which the charter or franchise was granted; that had amalgamation not taken place there was nothing to prevent the company from purchasing power from the Winnipeg General Power Company; that the electric power was generated at its power house; that technically in the by-law referring to power, steam-power and not water-power was alluded to, and that, therefore, the company had a perfect right to develop and generate water-power outside the city and bring it into the municipality for their purposes. The company further contended that if an injunction were granted stopping the transmission of electric power from the Lac du Bonnet generating station, 14,000 customers would be affected, and that there would not be enough capacity at its steam-power house in the city to care for the large load of power and lighting connected as well as run the cars of the railway system, which would result in crippling the company's entire system.

Ohio Independent Telephone Situation.

Among the late developments in the Ohio Independent telephone field is the election of Mr. James S. Brailey, Jr., to the vice-presidency of the Cuyahoga Telephone Company at a meeting of the board of directors, held in Cleveland last week. At the same time Mr. H. B. Taylor, treasurer of the United States Telephone Company, of which Mr. Brailey is president, was elected assistant treasurer of the Cuyahoga Telephone Company.

While in the city Mr. Brailey was questioned as to his intentions regarding the stock he holds in the two companies, but he gave little information further than to repeat the declaration that he stands with the Independents. He said he knows nothing about the information which Mr. S. B. Jeffries, attorney for the minority stockholders, claims to possess and can see no reason for his bringing suit in the Supreme Court of Missouri to have a commission appointed to inquire into the proposed merger of the Bell interests with the telephones of Missouri and Kansas. Mr. Jeffries is reported to have made the claim that he has a signed statement to the effect that Mr. Brailey turned over a portion of his United States Telephone stock to the Bell people through Day & Company, of New York.

Mr. Jeffries is said to have prepared a statement of his ideas and information regarding the matter for Attorney-General Denman, of Ohio, asking that proceedings be instituted in that State to prevent the alleged merger. In this he speaks of the transfer of stock to the firm of R. L. Day & Company. Late in the week Mr. Denman had not received the expected communication from Mr. Jeffries. He stated that if it should develop that the large properties of Independents in the State are being purchased for the purpose of combining them with the Bell system, then there would probably be ground for interference under the State laws, but if a syndicate of men is gathering up the properties with the purpose of a combined op-

position to the Bell interests, he did not think that there would be any violation of the law. It is only when competing interests unite that there is a violation of the anti-trust laws, as Mr. Denman sees the matter.

But in order to bring action at all, the Attorney-General must have some positive information as a basis. So far this seems to be lacking. No one has given any specific information as to the identity of the real purchasers of the Ohio companies. So far as the attorneys know, they may be deadly enemies of the Bell interests, while, on the other hand, they may be Bell representatives. Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company, Columbus, Ohio, is positive that his company has not gone into Bell hands. He says he will remain as president of the company and will have plenty of money for extensions and improvements, but that he does not know who the purchasers are, except that they are not Bell people.

Attorney-General Denman is watching matters closely and has collected some information, but it is not of the positive kind desired. The Department of Justice at Washington is also keeping in touch with matters through Assistant Solicitor-General Wade Ellis, who was at one time Attorney-General of Ohio and is acquainted with the situation in that State. However, there seems to be no information to be secured there, as all the influences at work have effectually covered the identity of those interested in the various purchases made.

It is said that the Independent interests in Ohio have applied to the President and Attorney-General of the United States to take action against the consolidation of the Bell interests and the Western Union Telegraph Company on the ground that they, in connection with the Postal Telegraph Company, are attempting to form a huge trust to control the wire service of the country. While it will not form an absolute monopoly of the business, they say that it will operate in restraint of trade and will prove a detriment in many ways.

At a meeting of 200 Independent telephone men in Columbus on Nov. 22 the committee of fifteen, named a week previous, made a report for a working plan to bring the companies of the State together for consolidation into one large company. The report recommended the employment of an engineer and accountant to examine each property and make a report on the physical and financial condition. From this information the committee and the owners shall agree upon a valuation, and in the event they cannot reach an agreement submit it to arbitration. Such an alliance or amalgamation as proposed shall take place only after companies, firms or individuals operating at least 50,000 telephones in the State shall have agreed. In arriving at values of properties the same methods shall be pursued in regard to all, but all conditions relating to each particular property shall also be taken into consideration. When agreements have been reached with the required number of companies, an Ohio corporation shall be formed which shall issue its 6 per cent cumulative stock, at par, upon the basis of valuation agreed upon for the properties or the majority of the stocks. For the good-will of the companies common stock in such amount as may be agreed upon, not to exceed 25 per cent of the par value of the preferred stock, shall be issued.

This plan was discussed for some time, but it was finally agreed that nothing should be done in the way of contracting or negotiating with any other company or individual for 90 days, so that all representatives might have an opportunity of discussing the matter with their boards of directors. It was also decided that a smaller committee would be able to handle the matter more expeditiously than a larger one, and the following five men were named to act: Messrs. O. M. Bake, Hamilton; Mark Cook, Mount Gilead; Col. H. A. Marting, Ironton; H. P. Folsom, Circleville, and Joseph McKell, Chillicothe.

The plan of the committee of fifteen was received with favor and will be used as a working basis. If the small committee finds that the work is too heavy for it, the members have authority to increase it to nine. Funds have been provided for prosecuting the work.

The greater part of both the preferred and common stock of the Columbus Citizens' Telephone Company was deposited by the date named by Mr. F. R. Huntington, who made the offer of purchase. Stockholders of the Dayton Home Telephone Company, of Dayton, were also depositing their stock rapidly and the indications are that the purchaser will secure practically all of it.

Judge Manton, of the Common Pleas Court, at Toledo, granted a temporary restraining order on Nov. 22 preventing the officials of the Toledo Home Telephone Company from interfering in any way with Herman C. Stifel, of St. Louis, in making an examination of the books of the company. Attorneys for the company filed a motion to dissolve the injunction, but this was overruled. The injunction was suspended for a few days, however, in order to give the attorneys time to prepare a petition for appeal to the Circuit Court.

New Tesla Wireless System.

Mr. Nikola Tesla has announced that as the result of experiments conducted at Shoreham, Long Island, he has perfected a new system of wireless telegraphy and telephony in which the principles of transmission are the direct opposite of Hertzian wave transmission. In the latter, he says, the transmission is effected by rays akin to light, which pass through the air and cannot be transmitted through the ground, while in the former the Hertz waves are practically suppressed and the entire energy of the current is transmitted through the ground exactly as though a big wire. Mr. Tesla adds that in his experiments in Colorado it was shown that a very powerful current developed by the transmitter traversed the entire globe and returned to its origin in an interval of 84 one-thousandths of a second, this journey of 24,000 miles being effected almost without any loss of energy.

Plans of Stevens Engineering Society.

About a year ago the Stevens Engineering Society of Stevens Institute, Hoboken, N. J., an undergraduate organization, became affiliated with the American Society of Mechanical Engineers, which step has led to a great increase in the activity of the body. Among the plans completed for the coming present season is a course of lectures by engineers and others representing the mechanical, electrical, civil, marine and other technical branches of knowledge, to be delivered on Tuesday afternoons from 4:10 to 5:10 p. m.

The body was addressed during October and November by President Jesse M. Smith and Secretary Calvin W. Rice, of the American Society of Mechanical Engineers; Messrs. Frederick A. Waldron, Fred. W. Taylor, Dr. F. R. Hutton, Dr. H. C. Sadler, Prof. Dugald C. Jackson and Mr. C. F. Scott. Among the speakers during the remainder of the season, which extends to May 10, are Rear-Admiral George W. Melville, Messrs. Hudson Maxim, D. S. Jacobus, Frank B. Gilbreth, Naval Constructor D. W. Taylor, U. S. N., John A. Brashear, and the following representatives of the electrical profession: Messrs. H. G. Stott, T. C. Martin and W. J. Hammer.

Electric Service Temporarily Crippled in Winnipeg.

An accident serious in its immediate consequences occurred to the plant of the Winnipeg Electric Railway Company at 4:30 o'clock on the afternoon of Nov. 23, when by the bursting away of either one of the penstocks or waterwheel casting, the generating station at Lac du Bonnet, 50 miles distant, was flooded. The transmission line to the city was immediately shut down, resulting in a complete closing down of the entire power, lighting and street-car service within the city. The first night the city was in almost total darkness, every resident and storekeeper having to revert to candles. The company

made an attempt to cope with the unfortunate situation by supplying steam-power from its reserve generating station in the city, but as this has a capacity of only about 8000 hp and the total peak load in the city is about 20,000 hp, only a partial street-railway service was run to take people to their homes, after which the service had to be reduced in order to care for domestic lighting.

A further trying accident occurred the next day at the steam plant, when a switch burned out, cutting off about 1200 hp. The city corporation came to the company's assistance by offering 100 hp from its steam plant at the water-works, and a rush job was made in order to connect up a line for this purpose. Industrial operations of the city employing electric power have been entirely shut down and a large number of workmen thrown out of employment for the time being.

Mr. R. S. Kelsch, of Montreal, the well-known electrical engineer, who is familiar with the Lac du Bonnet plant of the Winnipeg Railway Company, stated in an interview that he did not think the damage would exceed more than $25,000 to the company's plant. He gave it as his opinion that the accident was probably caused by the breaking of one of the penstocks or the casting of a turbine, resulting in the flooding of the wheelhouse and partially flooding the generating room. The high-tension switches and other regulating apparatus being located on the upper galleries could not be damaged in any way. It would take about a week's time in which to get the generators dried out.

Patents and Patent Law.

Addressing the Electric Club of Chicago, on Nov. 24, on "The Trend of Invention," Mr. George P. Barton, a Chicago patent lawyer, after referring to the fact that the association is representative of industries founded upon inventions that have been patented, said it has been stated that the greatest benefit to society of the patent law lies in the fact that it induces people to think. He then spoke of some of the embarrassments met with in the Patent Office on account of the practice that has grown up of requiring inventors to present a separate application for each small part of the main invention. He also said that he had been informed that one man had written more than 15,000 applications for patents, making $60 a week or 10 per cent of what the advertising patent agency charged. Inventors and those investing in patents in most cases receive nothing; probably not over 10 per cent, and probably less than 2 per cent of the patents issued have been profitable to the patentees.

In the year 1800, 41 patents only were issued by the United States; in the year 1850, excluding patents for designs, there were issued some 884 patents for inventions; during the year 1900 there were issued 24,660 patents, and during the fiscal year ended June 30, 1909, there were granted 34,332 patents for inventions. Perhaps there are now outstanding 400,000 patents. It is safe to say that in the aggregate these patents contain at least 2,000,000 claims. The exact number could be ascertained by counting, and possibly, said Mr. Barton, ironically, this undertaking would be as useful as some of our work in getting and sustaining patents.

In theory of law each of these 2,000,000 claims is a writ of prohibition against each one of 80,000,000 of people, commanding all not to make, use or sell what is thus claimed or patented except with the consent of the patentee, or the owner of the monopoly, for, within his domain, the patentee, in the language of the Circuit Court of Appeals, is czar.

"We must bear in mind," continued Mr. Barton, "that a patent gives the patentee or its owner no right to make, use or sell the invention which he would not possess if there were no patent. But it does give him, in theory at least, the absolute right to debar all others from practicing the invention thus secured. And thus, as I have said, each of the 2,000,000 or more outstanding patent claims, as some look upon the matter, is a menace to the whole people. In order to do business one must run this gantlet of 2,000,000 clubs raised to strike, and wielded with all the power and force of the nation.

"The most striking and marked trend of invention has been divisional. The several points of an invention are attenuated, and often each point is dignified by the red seal and blue ribbon of a separate patent. Some one may ask, 'How did such a system grow up?' I think few will contend that it is a system which is made only for the benefit of manufacturers, dealers and consumers. I do not believe that anyone of experience can seriously contend that such attenuation is beneficial to the inventor. But the system has grown up in a very natural way. In the early days of the Patent Office, there were only 50 or 100 patents a year, and as they were issued without examination, there was no need for 40 examining divisions and 400 examiners, such as are now a part of the Patent Office machinery.

"On the other hand, with 42 separate examining divisions, as is the exact number now, classification is necessary; and where some inventions relate to matters that must be searched for in two or more divisions, the rules and practice have forced inventors and their solicitors to split applications up in the way mentioned. It thus not infrequently happens that the inventor, when he comes to court, finds that he has fallen between two stools. The solicitor of patents, if compensated by a fixed fee for each application, may view with complacency their multiplication by acts of the Patent Office which he cannot control.

"It may be said that there has been a development, not only of examiners in the Patent Office, but also of solicitors of patents, and that the examiners of the Patent Office, in association with the solicitors of patents, have worked out a code of patent law, well understood between themselves, but incomprehensible to the layman, incomprehensible to foreign nations and hardly recognized by the courts."

The speaker referred to a recent case in which the judges of the Court of Appeals said: "This case is a striking example of the unfortunate result of too close adherence to rule. The inventor asked for seven claims. The logical way would have been to include the genus and its varieties in the same patent, and half a dozen claims would have covered every possible combination which he was entitled to hold. But by the time the Patent Office got through with him the inventor was the holder of four separate patents granted upon divisional applications split off from his original one, the four patents containing together 98 claims. It does not seem just that the patentee, who was powerless to obtain any modification of the rule for dividing applications, should be made to suffer from such misdirected energy."

Mr. Barton said that the patent law does not offer much in the way of honors, money or position. But, in spite of this, he likes it. In 1878, when the speaker began the practice of patent law, a friend said to him: "You are too late; all the inventions have been made." During the period that has elapsed from that time to the present, the trend of invention has been, perhaps, toward small improvements; but no doubt a small invention is worth more to-day than it would have been when the population of the country was one-twentieth what it is now.

But, after all, he said, the difficulties experienced by all interested in patent law are not greater than those encountered in other branches of the law. Instances of the technicalities of courts and the law's delays generally were cited. The great expense of patent litigation was also mentioned by the speaker, who referred particularly to the Seldon patent in the automobile cases.

In the discussion, referring to an allusion that Mr. Barton had made to Diana of the Ephesians, President F. P. Vose said that in view of some of the revelations that the speaker had made in relation to advertising patent agents, it was no wonder that Diana, the huntress goddess, should be regarded as the patron saint of patent law. In reply to a question if it might not be advisable to establish a technical court to decide the extremely technical questions involved in patent litigation, Mr. Barton answered that the American Bar Association had recommended the establishment of a Patent Court of Appeals, adding that there are now 10 courts of last resort in this country to pass on

patent questions. Mr. Barton suggested as a possible way of reducing the work of patent litigation, that the court call the parties to the suit before it for a preliminary hearing to see if the issues might not be defined before taking testimony. He also remarked that it had been urged that testimony in patent causes be taken under the direction of a master in chancery, with power to exclude what is irrelevant. The great expense of records of cases should be curbed. Clients are primarily to blame for delays, but it is also to be remembered that judges are only human in their capacity for work, and courts are very reluctant to interfere in cross-examinations. Mr. Vose closed the discussion by speaking of the immense amount of work thrown on the judges in the State courts and the importance of their decisions, also. Mr. Barton's remarks were instructive and were listened to with close attention. He received the thanks of the club.

Residence Lighting.

The regular monthly meeting of the New England Section of the Illuminating Engineering Society was held at the Edison Building, Boston, on the evening of Nov. 16. Mr. T. J. Little, of Gloucester, N. J., discussed gas lighting in the modern home, and Mr. E. C. Kimball, of the Boston Edison Company, reviewed the technique and application of electricity in the best lighting of residences.

Mr. Kimball pointed out that the introduction of high-efficiency lamps has altered the lighting situation with respect to the sufficient and economical illumination of residences. Reflectors have been redesigned and more satisfactory results obtained. The flexibility of electric light makes it most desirable to use this form of illuminant throughout the entire house, and with the proper consideration of color values in the finishings of the woodwork, as well as draperies, it will place itself on a par with any of the other types of illuminants now available. The quantity of light can be regulated to keep the expense of operation down to a minimum. The architect of a residence should, during the early stages of his work, associate himself with one who is by training and practice abreast of the times in regard to illumination, and seek such advice in these matters as will make the house as a whole satisfactory to all parties.

Considering the illumination of special rooms, Mr. Kimball took up the living-room problem and emphasized its predominance over the rest of the house. The reading light is the most important. To illuminate the room at a high intensity and thus make reading possible at any point is too expensive. By equipping the reading lamp with a suitable reflector which will not only concentrate the light enough at a single place for reading, but which will give a good average lighting throughout the rest of the room, the best results will be secured. In small rooms this can be done by ceiling fixtures rather than table lamps, which latter are undesirable from an illuminating point of view. In parlors it is sometimes necessary to modify the light to meet architectural requirements. The degree of light in such rooms is not ordinarily as high as in living-rooms, and chandeliers with small units generally meet the conditions. The dining-room is the simplest problem in residence lighting. If china cabinets, cut-glass, silver cabinets, buffets or fireplaces are to be lighted, care should be taken to avoid exposing the bare lamp or filament to the eyes from any position. A single strong light supplied by a hanging fixture above the table, with a good reflector, will meet the needs of the situation in most cases. Too great intrinsic brilliancy reflected from table linen to the eyes should be avoided. A subduing screen of white silk supported directly below the lamp is often desirable when using high-efficiency lamps. These fixtures are to be considered more from a decorative point of view, and small wattage lamps usually are sufficient.

Mr. Kimball stated that in lighting bedrooms first cost is a vital point. The variety of points at which light is from time to time required make it difficult to provide the requisite service at low cost. The illumination of the dresser by lamps on each side of the mirror, preferably on swinging arms, is desirable. A general illumination of the room by a chandelier or pendant lamp placed above the line of vision and with the medium concentrating shade of the prism type, will permit sufficient light to reach the ceiling to create a general warmth and cheery appearance. Control from the bed is an important point. Small candle-power lamps in closets are very desirable. The best general illumination in a house is required in the kitchen, the maximum flux of light being required at the sink and stove. Clean food and dishes require ample light, and good general illumination has a direct relation to the servant problem. In bathroom lighting the installation of lamps on each side of the mirror is the chief requisite, and the use of a small lamp over the center of the mirror is also good practice. For the general illumination of this room a single unit placed close to the ceiling with a so-called prism reflector, giving a general warmth to the appearance of the room, is desirable. The usual light finish of bathrooms permits the use of low-candle-power lamps in such cases. Ceiling lights give better results than wall bracket units. The latter tend to concentrate the light without giving the widest angle of distribution. The intensity of illumination required in halls is usually much less than that desirable in living-rooms, libraries and kitchens. With short halls equipped with a single outlet, the lamps should be placed close to the ceiling and at an angle, with proper reflector, which will throw the light downward toward each end of the passage. The most desirable method of illuminating porches and piazzas is by a concentrating reflector of the ball or hemispherical type, arranged to throw its maximum light downward on the porch and to illuminate fully any person standing at the door. Basement lighting is a simple problem usually, and here small units may be installed, but these should be of a simple type and easily kept clean.

Concluding, Mr. Kimball pointed out that from 1-foot candles to 2-foot candles are usually satisfactory for residence lighting, the higher intensity being used in living-rooms and libraries. A room with dark furnishings and draperies of a subdued color will naturally need the higher intensities of lighting for satisfactory results.

The Exhaust Steam Turbine for Central-Station Work.

The regular monthly meeting of the Boston Branch of the American Society of Mechanical Engineers was held at the Massachusetts Institute of Technology on Nov. 17, with Chairman Ira N. Hollis presiding. The subject of the evening was the low-pressure steam turbine. Mr. H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Company, New York, was the first speaker, whose subject was the New York Interborough 5000-kw exhaust-steam turbine plant described several months ago in these columns. Mr. Stott emphasized the novelty of the low-pressure turbine at the time of its selection by the company in connection with additional power equipment about a year ago. The Interborough engines in the Fifty-ninth Street station are of the Manhattan type, so-called, with Corliss valve gearing, having a 42-in. horizontal high-pressure cylinder and an 86-in. vertical low-pressure cylinder on the same crank-pin. A duplicate of this equipment is situated on the opposite side of the generator, the latter being located between the two engines. The speed of the unit is 75 r.p.m., and the generator rating 5000 kw. The only flywheel is the revolving field of the generator, and hence an enormous weight was required in the latter, enabling the unit to carry 8000 kw continuously with a temperature rise of only 35 deg. C. The company was, however, unable to make use of the large capacity of the unit on account of the inefficiency of the engine at the higher outputs. The efficient output was secured between 4000 kw and 6000 kw. The water rate was so high at 8000 kw that the capacity was not used.

It was determined that adding a high-pressure turbine would not in any way improve the efficiency of the power plant, which

was good, with the station only four years old; but that adding a low-pressure turbine would increase the capacity and at the same time improve the efficiency of the engine. A vertical shaft, three-stage Curtis turbo-generator was installed, the rated capacity being 5000 kw. This turbine receives steam from the two engines mentioned, and together they make up an 8000-kw unit. The steam at first is let into a separator, which was installed with the idea of separating the oil and the moisture, about 10 per cent oil and moisture being expected. From the separator the steam is taken into the low-pressure turbine, which has no governor, except an emergency equipment to prevent its running away. The dynamo on the turbine is an induction generator, coupled permanently to the leads of the main alternator. The man operating the switchboard does nothing with this generator and does not know it is there except by looking at the wattmeter. The turbo-generator starts as an induction motor, the turbine being picked up and brought up to speed. As soon as the load is on the engine, it is synchronized on the system, the low-pressure turbine taking about 80 per cent of the load. As the total load increases the load on the two units becomes more nearly equal, so that at 15,000 kw total load on the combined engine and turbine, each carries approximately 7500 kw. The load is an exceedingly difficult one to carry, as there is a constant fluctuation plus and minus of 15 per cent, sometimes at three-second intervals, sometimes at five-second intervals and sometimes at 60-second periods, depending upon train movements.

The first separator installed was unsatisfactory. There were numerous baffles which became loosened, and which had to be cut out, leaving nothing but the shell. The whole secret of a separator is to build a receiver large enough, with horizontal baffles to protect the water as it is being trapped out and removed by the pump. The separators now being installed are about 28 ft. long and 8 ft. in diameter, and notable improvements are being expected. The importance of getting rid of the moisture in turbine work is great. For every 1 per cent of moisture in making corrections, 2 per cent must be allowed for friction loss, in addition to the loss in the power of the steam. The separator first installed gave only 88 per cent to 92 per cent of steam entering the turbine. Lately this has been raised to 95 per cent or 96 per cent.

By means of the turbine the old unit has been brought up to a point where the company is able to get full rating out of the generator and still hold extremely good economy. Instead of having 10,000 kw, the company now has a possibility of about 15,000 kw. With the turbine separation of oil from the steam is thoroughly successful. The fuel economy of the plant has been improved about 23 per cent. Including labor and maintenance the net operating economy of the unit is improved about 30 per cent. The cooling surface of the condensers is used about 87 per cent more efficiently than in previous practice. The capacity has been more than doubled.

Mr. W. L. R. Emmet, of the General Electric Company, emphasized the possibilities of the low-pressure turbine in improving reciprocating-engine operation generally. Retention of economy at overload is one of the great points in low-pressure work. The combined engine and turbine is efficient through a wide range of load. The steam engine has a certain capacity in low-pressure cylinders, which is limited by the mechanical possibilities of moving the piston and valves at sufficient speed. If the cylinder is made larger the result is simply an exposure of more surface and a great increase in mechanical difficulties. There are many overloaded engines in the mills of New England, running far beyond the economical point. Where the load is variable a large part of the total energy is delivered inefficiently. The combined plant shows an efficiency of about 22 per cent compared with about 72 per cent actual thermal efficiency of a perfect engine.

Mr. Emmet said that the Interborough boiler plant capacity had been increased by Mr. Stott in connection with the turbine installation. The doubling of the station capacity by ordinary means would have cost probably $200 per kilowatt, including real estate. It is safe to say that everything which has been done has cost under $30 per kilowatt. The same thing is available for anyone who runs a steam engine or has use for electricity. An overloaded mill engine can be increased from 50 per cent to 100 per cent in capacity, or the overload on the engine can be reduced by taking off some of the load and directly connecting it to electric motors, driving the latter from a generator on the low-pressure turbine. In one recent investigation it was estimated that by a certain change in existing conditions an installation of low-pressure turbines and the addition of one or two boilers, filling up the existing station, it would be possible to add 40,000 kw to the plant at a cost of $40 per kilowatt. This would all be accomplished through the capacity of the turbine to handle an indefinite expansion of the steam. The steam engine is more efficient in the high-pressure ranges than any turbine will probably ever be. The steam expands and pushes the piston and the only losses are certain thermal and friction losses. In the turbine the operation of the steam is indefinite. It simply impinges upon a surface and that impact is more or less inefficient. Ideal efficiency can never be obtained with the turbine, but with it one can work through a wide range of steam activity; ranges that an engine is incapable of touching. Most engines will run non-condensing advantageously when necessary. It is possible to use a turbine as a low-pressure machine and have at the same time a reserve high-pressure capacity. The governor will automatically put high-pressure steam in it when the low-pressure steam is inefficient. There is a great field for these machines in New England.

The Electric Vehicle and the Central-Station.

The regular monthly meeting of the Electric Vehicle and Central-Station Association was held at the Edison Building, Boston, on Nov. 22, with President Frank J. Stone in the chair. A large attendance evidenced the interest now being awakened in New England central-station circles in this source of business. Before the meeting began the members and their friends in attendance made a thorough inspection of a number of modern electric trucks lined up in the street below. President Stone then called the meeting to order with a short address on the latest progress in the electric vehicle field. In the past nine months the number of electric vehicles in operation in Boston and vicinity had increased 100 per cent. The interest in the subject is far from being a passing flurry. There are now eight electric vehicle garages where there were but two before, although New England is still far behind in this business in comparison with Western cities.

President Stone announced that later calculations show that the annual current consumption of one light commercial vehicle equals that of 400 incandescent lamps; and that the annual consumption of one of the heaviest commercial vehicles equals a connected load of 935 incandescents. One hundred average electric vehicles would mean a current consumption equal to a connected load of 6670 lamps. The work of the solicitors in getting the second hundred would be easier than the first. What central-station manager would refuse to seek such business and what solicitor would expect to hold his position if he did not go after it?

Mr. Stone urged that a progressive attitude in one commercial house in regard to electric vehicles will force others to follow it. The value of cleanliness, prompt delivery and the reputation of being up to date is great. The taxpayer is bound to assert his rights sooner or later to cut down the cost of street cleaning. In several large cities the transportation companies refuse to admit other than horse-drawn or electric trucks to their warehouses on account of fire risk. This will become more general, in the street as well as in the warehouse. If the horse and his action could be removed from sight and the slow progress made in handling merchandise noted, the situation would at once appear intolerable. The off-peak load of the vehicle charging business should appeal to all. Mr. Stone said in conclusion that while the electric vehicle will make headway independently of the central station, it will make more rapid prog-

ress with its co-operation. The central station should control this business from the start and not allow it to fall in the hands of the isolated plants. The present means of inefficient transportation of freight through cities must give way to electrical methods. After transportation companies deliver freight at their terminals, the work that follows in its distribution is two or three times as great as when there is but one party to deal with, and if this party had a franchise allowing him to handle all the freight, the use of electricity would be imperative.

Mr. Alexander Churchward, of the General Electric Company, then stated that in Chicago there are 2300 electric vehicles and about 250 new ones being added yearly. The East became disgusted over the situation as a result of its early ex-

COST OF OPERATION.

Yearly miles.	Wagon type.	Per day.	Per vehicle mile.	Per ton mile.
10,000	1,000 lb.	$6.85	19.5 cents	39 cents
10,910	2,000 lb.	7.51	21.5	21.5
9,060	4,000 lb.	8.85	39	19.5
*7,800	7,000 lb.	10.80	40	11
*6,900	10,000 lb.	11.47	49	10

*Figures on 27 and 25 miles per day respectively.

periences with vehicles of a design not equal to the present-day standards. The energy consumption has been cut from 120 watt-hours to 60 watt-hours per ton-mile in the past four years. Instead of running on a two-hour to three-hour discharge rate, a vehicle now runs well on a five-hour or six-hour rate. Six years ago the cost of running a vehicle was prohibitive. Tires now run 15,000 miles compared with 3000 miles before. The weight of the vehicle has been reduced, longer life obtained in all important parts, and improved controlling apparatus adopted. High speed and spectacular hill-climbing "stunts" are not for the electric machine, but it is the simple, reliable car. It can pull out of a hole where many a gasoline car is helpless. With gasoline at 12 cents per gallon, the electric vehicle will beat it on economy, with energy at 4 cents per kw-hour. The battery up-keep is less than the maintenance cost of gasoline motor and gears.

Mr. Churchward emphasized the importance of low speed in cost reduction, especially in comparing electric with gasoline trucks. The latter cannot be run over city pavements at from 12 to 15 miles per hour without enormous cost. An electric truck will run 40 miles per day against 12 to 15 miles by horse, and at seven to eight miles per hour against 2½ by horse. He stated that the following guarantees could now be made.

Cost of operation, including energy at 4 cents per kw-hour, interest, depreciation, fire and liability insurance, wages of driver, battery-man and assistant, washer, rent at $1 per square foot of garage per year, tire renewals, gears.

In conclusion, Mr. Churchward said that conservative speeds with pneumatic-tired vehicles of the electric type varied from 20 miles per hour with the 1500-lb. wagon to 16 miles per hour with the 4000-lb. truck; and from 16 miles per hour with the solid-tired 2000-lb. wagon to six miles per hour with the 20,000-lb. truck having solid tires.

Mr. C. F. Smith, of the Boston Edison company's automobile department, then presented a number of lantern slides of the

OLD TYPE DOUBLE-MOTOR, PEDESTAL JAW, GEAR DRIVEN, GENERAL VEHICLE COMPANY CAR.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	Capacity.
1	1907	377	325.	1.1	$36.20	$50.01	2000 lb.
	1908	339	420.	.8	70.72	50.46	
4	1907	181	213.	.8	15.61	29.38	1000 lb.
	1908	194	215.	.8	37.20	44.20	
	1909	272	139.	2.0	26.26	34.34	
9	1907	431	366	1.1	74.80	85.40	2000 lb.
	1908	432	272	1.6	68.69	108.35	
	1909	238	167	1.4	9.81	24.03	

electric vehicles the company has operated in its own service during the past few years. He said that as a result of the electric vehicle's reliability the company has not had an electric automobile laid up for a single day in 1909. These cars are run on a schedule out of the garage which does not vary seven minutes in a month. President Edgar's private electric automobile has run 40,000 miles in the past seven years, and has never been laid up on the road. Mr. Smith paid a tribute to modern designs and the value of acceleration in crowded districts. Here the electric machine is supreme. Various electric cars used in construction service were shown, and the company will shortly place in service a new car for use in pumping out manholes.

NEW TYPE SINGLE MOTOR, CHAIN-DRIVEN CAR.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	Capacity.
38	1909	548	175.	3.1	$5.86	$7.97	1000 lb.
60	1909	453	138.	3.2	.00	5.69	1000 lb.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	Old type
	1907	236	466.	.51	$39.28	$45.93	3-ton truck Gen. Veh. Co.
3	1908	178	355.	.50	109.32	63.09	New type
49	1909	393	336	1.2	5.05	11.66	3½-ton truck Gen. Veh. Co.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	
12	1907	310	166.	1.9	$12.39	$68.04	Waverly runabout
	1908	162	85.	1.9	12.47	9.36	
42	1909	683	153.	4.5	10.88	17.81	Baker runabout

COMPARISON OF TWO BOSTON EDISON ELECTRIC VEHICLES.

	Old type.	New type.
Capacity	1,000 lb.	1,000 lb.
Car weight	4,000 lb.	3,240 lb.
Miles per charge	25	40
Battery weight	1,275 lb.	1,050 lb.
Speed	12	12.
Current	42 amp.	23 amp.
Battery life	3,500 miles	7,500 miles

In the course of his description of the vehicles Mr. Smith submitted the above data comparing the cost of repairs and the mileage of the earlier with the latest electric machines, stating that in general the new types have more than doubled the mile age per kw-hour of charging energy.

Thirty Years of Electrical Development.

In an address recently delivered at the fourteenth annual meeting and dinner of the Electrical Trades Association of Chicago, Mr. Samuel Insull gave an interesting account of his connection with the electrical industry and of electrical development during the past 30 years.

It is about 31 years ago, Mr. Insull said, when one night in November, 1878, he was standing upon a dingy platform of the Metropolitan Underground Railroad of London waiting for a train to take him to the house of one of the leading editors of one of the London weeklies, into whose service as shorthand writer, or as it was then called, shorthand "clark," he had entered, to eke out a small salary received for other services in the city during the day, that his eye happened to rest upon an American magazine at a bookstand. As he had a ride of some half or three-quarters of an hour, he bought the magazine, and in it he found, merely by accident, a very entertaining article descriptive of the work of a man whose name, although well known in America, was comparatively little known outside of the United States, but a name that to-day is a household word wherever current literature circulates—Mr. Thomas A. Edison. At that time little was known of the telephone, and but few in the world knew anything about electric lighting, but Mr. Insull said that the article he read that night affected his career in a way then little anticipated, for within three months, purely an accident, after being engaged by an American who had an office in Lombard Street, in London, he found he was private secretary to Mr. Edison's European agent.

Looking back, it seems almost impossible to realize that at that time, when he was on the threshhold of his career in the electrical business (January, 1879), that there was little or nothing in the way of telephone service. There were then a few telephone exchanges in this country. The first one was opened in New Haven some time during the previous year, 1878; but one could not find anywhere outside of the United States in the spring of 1879 a telephone exchange. The first one erected in London was put in service some time in the fall of 1879, and Mr. Insull said it was his privilege to operate it for the first half-hour that it was in operation.

As to electric lighting, in Europe some work had been done by Von Siemens and some of his associates, and there was a distinguished Russian engineer by the name of Jablochkoff, who had produced what was known as the Jablochkoff candle, a form of arc lamp which was exhibited on the Avenue de l'Opéra in Paris in 1878, and a few months later on the Thames Embankment and Waterloo Bridge in London. Mr. Jablochkoff's efforts, although of great consequence in the development of the art, outlived his first experiments only a very few years, and had no effect in this country except that in 1881 a few lamps were put on exhibition by the late Mr. Charles Cheever, who made quite a reputation in connection with the early introduction of the telephone.

It was at the Centennial Exposition of 1876 where Alexander Graham Bell first exhibited an instrument that imperfectly carried the utterances of the human voice electrically over a wire. There are some enthusiastic admirers of Mr. Edison who claim that they saw experimental telephone instruments in use at Menlo Park a little prior to that, which gave as much in the way of conversation as the work of Mr. Bell. Mr. Insull, however, said he had no doubt that all present at the dinner believed that the credit for the invention of the telephone must be given to Alexander Graham Bell, just as he thinks that the credit for the invention of the carbon transmitter that we all use to-day, whatever may be the claims of other inventors, must be given to Thomas A. Edison.

Referring to the electrical supply business represented by the Trades Association, 30 years ago the only material to be sold was that required for telegraphic and house-bell work. There were three supply houses in New York, those of Tillotson, Bunnell and Charles T. Chester. The Western Electric Company, of Chicago, had a branch at that time in Church Street, New York, and also did more or less of a supply business. At that time the greater part of the supply business was done on special orders by mail, and about the only concerns aside from those mentioned were Partrick & Carter, of Philadelphia; Watts, of Baltimore; Buell, of Cleveland, and Charles Williams, Jr., of Boston, who was afterward taken into the Western Electric Company, and E. T. Gilliland, who did more or less of a supply business in Indianapolis.

Mr. Insull said he could remember when he arrived in New York in 1881, Tillotson and Bunnell had establishments somewhere in the neighborhood of the then and present Western Union Building, on the side streets from 195 Broadway. When one went into their stores, they resembled more a storehouse of one of the big iron wire concerns than what one would now consider an electrical supply store. The business was of little or no national consequence, and as it exists to-day is so entirely different that one was forced to the conclusion that it is really a product of the last quarter of a century.

Referring to telegraphy, he said that if one wanted to send a message from London to New York at that time, he believed it cost a dollar a word; he was more familiar with the rate from the other end of the line, which was four shillings a word. As to telegraph tolls, the telegraph rate between New York and Chicago 30 years ago was $1.15 for 10 words, and the rate between New York and San Francisco was $5 for 10 words.

In 1879 the only electric light service that anything was known about in this country was the work of Mr. Brush, of Cleveland, of Elihu Thomson and Professor Houston and a few others who were engaged in the series arc light business. Mr. Edison's work on incandescent lighting was just being talked about, and was first discussed in the public press in December, 1878. This discussion was followed by a rather sensational drop in the price of gas shares the world over, but it was not until about a year later, in 1879, that Mr. Edison made his first exhibition at Menlo Park of his paper-carbon lamp, and it was not until the summer of 1880 that any of these experimental lamps found their way outside of the laboratory. Mr. Insull said that it was his privilege in August, 1880, to see one of Mr. Edison's first lamps lighted up to a dull red in the basement of a building in Queen Victoria Street, London, the energy for lighting the lamp being supplied by about 40 cells of Grove battery.

When Mr. Insull came to this country on the first of March, 1881, the main discussion in the public press with relation to electrical matters turned on whether Edison had, to use a popular expression of that day, succeeded in subdividing the electric light, or whether the claims that he made of success in that direction were simply the vaporings of a very wild imagination.

There were very few people on either side of the Atlantic who had any belief whatever in what had been accomplished up to that time. Notwithstanding the fact that there was then a complete system of two-wire underground distribution, fed by feeders from a central point, and that that system was operating lamps and motors in multiple, out at Menlo Park, there were very few people who had the slightest belief in the commercial value of Mr. Edison's work. Mr. Insull recalled being taken on the second night he was in this country out to Menlo Park by Mr. Edison, arriving there about 9 o'clock in the evening, and spoke of his surprise in seeing the fields around the laboratory, the houses of Edison and his assistants, all illuminated by this wonderful new light, using a carbon-filament lamp, a decided improvement on the paper-filament lamp which he had seen in London the August previous. He took occasion to run down to the depot from the laboratory, about half a mile away, to send a cable to friends in London, telling them that he had seen Edison's system in operation; about 10 or 12 days later an acknowledgment was received from the man to whom the cable was addressed, a man who is now the representative of the Western Electric Company of Chicago in London, who said he supposed Mr. Insull had been in America just about long enough to be able to draw the bow as long as any of those Yankees with whom he had been associating.

It is a matter of very great interest, he said, to those who follow the engineering side of this business to know that this first exhibition of Edison's electric lighting system at Menlo Park obtained its power partly from a direct-connected unit, composed of a dynamo of Mr. Edison's design, and an engine manufactured by Mr. Charles T. Porter, the engine being of the type commonly known throughout the country as the Porter-Allen engine. The engine was possibly of about 60 hp, and ran somewhere between 500 r.p.m. and 600 r.p.m. Mr. Insull said it is rather remarkable that the first engineering effort in connection with the development of the great industry which goes such a long way toward supporting practically all of the businesses represented at the dinner outside of the telephone interest should have been so true as to be composed of a class of apparatus that we have all gone back to upward of a quarter of a century afterward. This he thinks is one of the greatest tributes to Mr. Edison's engineering ability.

In asking to be excused when, in reviewing electrical progress during the last 30 years, he mentioned the name of Mr. Edison so frequently, Mr. Insull said that as he understood electrical development, and according to the annals of the Patent Office of the United States, one is forced to the conclusion that at least from one-half to three-quarters of the electrical development which is enjoyed at the present time can be traced fundamentally to the great intellect, the great genius, of the man under whose name it had been his privilege to work for 30 years.

It was not until 1882 that the first central station for incandescent lighting was put in operation in New York City. At that time the telephone business had attained considerable proportions. The old fight in this country between the Bell interests as represented by the American Bell Telephone Company, and the Edison interests as represented by the Western Union Telegraph Company, had been settled, and the entire telephone business was operated then, as it is largely now, as a monopoly business.

About the same time that the central-station electric lighting plant was started in New York on Pearl Street, just south of Fulton Street, there was a small plant started at Appleton, Wis. Largely on account of its small size and the ease with which

the smaller apparatus could be produced, the chances are that the Appleton plant started before the New York plant, and therefore the Central West probably can claim the honor of starting the first commercial incandescent lighting distribution system in the world. There had been various efforts made in Europe, but they were mainly in the direction of series lamps—that is, lamps of low resistance, run in series; but all systems of that character have long since disappeared as being uncommercial.

Right after the starting of the New York and Appleton plants there were plants started in London, but only for exhibition purposes, and soon plants were started in Santiago, Chile, and in Milan, in northern Italy.

In 1879 the first miniature electric railway carrying passengers was put in operation at the Berlin Exposition, by Siemens & Halske. It was purely an exhibition plant and it was not until two years later that any commercial road was put into operation in Europe, and that was a small one outside of Berlin, a mile and a half long. About the same time, or maybe a year later than the exhibition of the miniature railroad by Siemens & Halske in Berlin, there was a similar exhibition in Chicago on the Lake Front, in the old Exposition Building, of a little circular railroad, but not to carry passengers.

The progress that followed came in rapid succession, but it is an interesting thing to note that it was not until 1881 that there was any official definition of any of the electrical units, and it was at the Paris Exposition of 1881 that the ohm, the volt, the ampere and the coulomb were first authoritatively defined as the basis for legislative action in the various countries.

It was in this same year that the first "box of electrical energy," or what we call the storage battery of to-day, was carried from Paris to Glasgow by Sir William Thomson, afterward Lord Kelvin. It was one of the first storage batteries, and made by Camille Faure, and its unique demonstration attracted a great deal of attention at that time, but it was years afterward before the Faure cells came into general use.

At the Exposition of 1881 was the first demonstration of a direct-connected dynamo and engine, outside of Menlo Park. Mr. Insull said he had the privilege of having a great deal to do with the manufacture of that first unit in New York and its shipment to Paris. Mr. Edison's exhibit in Paris of that unit was made by Mr. Charles Batchelor, an early assistant.

About 1886 the alternating system began to come into general use, and some time prior to that period the three-wire system of Edison's was put into use, and the amount of copper necessary for the direct-current system was cut down about 60 per cent. The introduction of the alternating system and the Edison three-wire system gave a tremendous impetus to the electric lighting business, and one began to see springing up all over the United States establishments for the sale of apparatus. Mr. Insull added that from his own personal experience and much to his own cost, he could assure the audience that at that time a credit association was needed very badly indeed. (Laughter.)

The first serious efforts at electric railway work in this country were in 1888. Some years earlier, in 1880, Mr. Edison had built an experimental road at Menlo Park, and Mr. Stephen D. Field had done some work in connection with electric railways, but it was not until 1888 that Sprague's first electric road was started at Richmond, Va. In the same year, 1888, the first central station was established in the city of Chicago. At that time there was a large number of isolated plants, in fact, more in Cook County for the population than in any other part of the United States, but no effort had been made in the direction of central-station work until some time in 1887, when the Chicago Edison Company was formed. In 1888 its first central-station plant was started at 139 Adams Street, and when Mr. Insull came to Chicago in July, 1892, the plant had arrived at the enormous proportions of somewhere between 3000 and 4000 hp.

In this same year (1888) Mr. Tesla contributed very materially to the development of the alternating side of the business through his polyphase-current inventions, which form the basis largely of the alternating dynamos and motors of to-day.

The first electric power transmission was in 1890, this being a system laid out in a small town at one of the mines in Colorado. The next milestone in the progress of the electric lighting art was signalized by the Chicago World's Fair of 1893. That was, above everything else, an electrical display. One finds that there they got back to the direct-connected dynamos, using marine types of engines for the purpose, and a couple of those engines, which were shown at the World's Fair, are still in use at the Harrison Street Station of the Commonwealth Edison Company. The X-rays were discovered by Roentgen in 1895, and in the same year Marconi effected communication by wireless telegraphy in Italy for the first time.

Since then has been made the most wonderful progress. The first large American steam-turbine unit started in Chicago in 1903. The steam turbine had met with more or less success in different parts of Europe, and especially in England, a number of years prior to that, but the large use, or rather the use of large units as they are now understood, in the central stations of to-day, where units running up to as high as 22,000 hp are used, dates as recently as Oct. 2, 1903, when the first unit was started in the Fisk Street station of the Commonwealth Edison.

Some of the figures of the investments in the electrical business are simply stupendous. In Chicago alone there is probably invested in electric lighting, telephones, the electric portion of the street railways and the elevated railways, and the isolated electric lighting plants throughout the city, a sum which must exceed $500,000,000. "Just imagine for a moment what that means. Here we are, engaged in a business that a little over 30 years ago was never dreamed of, and to-day we have as customers of the concerns which are represented in this room, businesses that employ a capital of $500,000,000. The figures are simply stupendous."

There are at the present time 5,500,000 telephones in use in the United States, and the amount invested in exchanges and the lines connecting them is upward of $550,000,000. There is a track mileage of electric and interurban railways of 40,247 miles, using 89,216 cars, and representing capital liabilities of $4,557,000,000. Mr. Insull said that, of course, those figures represent capital liabilities and probably some of that capitalization is water, but personally would very much doubt if the cash invested in electric street and interurban railways at the present time is less than $3,000,000,000.

Turning again to electric lighting investments, there are about 6000 central stations in the United States to-day. Of this number upward of 3000 of the companies engaged in central-station work are also in the electrical supply business, a business that 25 or 30 years ago the representatives of which could be counted on the fingers of one hand.

The central-station companies of the country have an investment of $1,250,000,000. They have a gross income of upward of $250,000,000 a year, and they develop somewhere between 2,000,000 hp and 2,500,000 hp.

The total investment engaged in the several departments of the electrical business exceeds upward of $6,00,000,000; and that entire business has been created by the inventors of this country, who have no rivals anywhere on the earth in what they have been able to accomplish anywhere; in the ability of these inventors to produce that which would be commercially successful; by the wonderful confidence of the capitalists of the country; and by the adaptability of the people of this country to seize upon new things which are conducive, either to their comfort or to the economy of manufactures or to the improvement of means of communication and transportation.

In conclusion, Mr. Insull said that all in the audience can congratulate themselves, first in being privileged to take part in this remarkable business, and secondly, in being located in a country where whatever new things may come along, if they are things which recommend themselves alike to the capitalists who provide the money and the users, who provide the revenue from day to day, they are promptly adopted. "All I can hope is that the success of the last 30 years is only an indication of the great advances that all of us hope and many of us believe are likely to take place in this wonderful electrical business, in which we are all so proud to be engaged."

Canadian Hydroelectric Commission News.

Disallowance of the Ontario legislation respecting the Hydroelectric Power Commission has been asked of the Government by a deputation from Hamilton, London and Galt, Ontario. It was argued that the legislation was arbitrary, affected foreign investment and that Galt had been forced into the scheme unwillingly. The Premier replied that the question of disallowance was under consideration.

Another attempt has been made to have the Dominion Government disallow the legislation passed by the Ontario Government in connection with the Hydroelectric Commission. As previously reported this question was presented to the Dominion Government some weeks ago by a formidable array of eminent counsel who contended that the acts of the Ontario Government were illegal and urged the disallowance on technical grounds.

On Nov. 24 a deputation of prominent citizens from Hamilton, Galt and London waited upon the Premier and members of the cabinet. They represented that the legislation was arbitrary, illegal and not in the interests of the public as a whole. It was pointed out that the investment of capital from abroad had been injuriously affected, and particularly so in the case of the town of Galt, which had been compelled to join with the other municipalities in the scheme against its will. The members of the deputation declared that if the people of Ontario had real knowledge of the situation, the vast majority would demand the repeal of the act.

Sir Wilfrid Laurier in replying said that there was much force in the arguments advanced, and the question of disallowance was now before the Government, which would have to consider it from both the standpoint of its constitutionality and with due regard to the expediency of disallowing any provincial act affecting principally the people of that province.

Wisconsin Rate Commission News.

A petition signed by the Business Men's Association of Fond du Lac, alleging that the practice of the Wisconsin Telephone Company in issuing telephone directories for its Fond du Lac exchange, containing advertisements of local and foreign business houses, has caused injury to the trade, business and calling of petitioners, and praying for an order compelling respondent to furnish directories free from advertisements, excepting only those which advertise the telephone business of respondent, was acted upon by the commission on Nov. 24.

It was brought out in the hearing that the directories were furnished free to respondent by an advertising bureau, the advertisements being under censorship of respondent, and that it is customary to include advertisements in telephone directories.

The petition was dismissed on the grounds that "any act, practice or collateral undertaking of a public utility, not affecting prejudicially the reasonable performance of its duties and obligations to the public and individuals, although displeasing to some of its patrons because tending to subject them to prejudice in respect to their private interests, is not within the scope of the regulative powers conferred upon the commission; that the universal practice of telephone companies of using their directories as advertising mediums is a practice collateral to the public functions of such companies; and as long as not interfering with its discharge of such functions, is not within the regulatory powers of the commission; that the respondent furnishes adequate directories to the petitioners and to the public and the use of the same as for advertising purposes does not impair its serviceableness to the public."

The State law requiring street railway companies properly to heat all cars between Oct. 15 and April 15 was violated by the Southern Wisconsin Railway Company, and on Nov. 18 the commission ordered the said company to comply immediately with the State law. The cars must be equipped with a reliable thermometer placed in a conspicuous place at or near the center of the car and a temperature of not less than 60 deg. Fahr. at or near the center of the car must be maintained when reasonably possible to do so. A fine of from $50 to $100 is provided for violations, each day such car is operated to constitute a separate offence.

New York Public Service Commission News.

Chairman Willcox, of the Public Service Commission of the First District, last week wrote a long letter to Theodore P. Shonts, president of the Interborough Rapid Transit Company, condemning the proposals made by that company for the construction of subways and declaring that the commission considered them unfair to the city, obstructive of other subways in the future and inadequate to the needs of the people. The letter amounted to a total rejection of the Interborough's plans. The company has as yet sent no response to the commission and has not indicated whether or not it is to be further considered in connection with the construction of new subways.

After many hearings on the question of heating street cars in New York City the Public Service Commission last week issued an order requiring all cars to be supplied with suitable heating apparatus and between Oct. 15 and April 15 to maintain in every closed car a temperature of not less than 40 deg. Fahr. nor more than 60 deg. Fahr., unless temporarily prevented from doing so by storm or accident. The order takes effect on Dec. 10.

The Second Avenue Railroad Company has applied to the Public Service Commission for permission to electrify that portion of its line running through North Street from Chatham Square to Broadway. This track has not been operated for years for traffic, although a horse car has been run over it to preserve the franchise. A hearing was ordered on the application for Dec. 1. The receiver of the company has already been authorized by the courts to equip the tracks for electricity.

Upon complaint of the Board of Trade of the Twenty-fourth Ward, of Brooklyn, the Long Island Railroad Company has been ordered to show cause why it should not be compelled to use electric locomotives only in its subway through the city of Brooklyn.

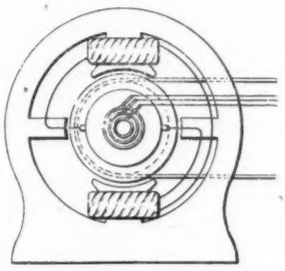
The Public Service Commission has suggested to the New York Central Railroad Company that if it is willing to build tunnels under the streets of Manhattan, for its Eleventh Avenue tracks, under the same laws by which the Pennsylvania Railroad got its franchise, it may apply for the privilege without any further legislation. It is said that the Central has expressed a willingness to spend $60,000,000 on such a project.

The Public Service Commission of the Second District has received a complaint from the residents of the village of Canandaigua against the Ontario Light & Traction Company as to alleged poor service rendered by that company in furnishing electricity for light and power in the village of Canandaigua. It is stated that the company depends almost entirely on Niagara power to furnish service, having but two other stations, one at Canandaigua and one at Littleville, about six miles distant. It is stated that in the past six or eight weeks the quality of electricity which has been given is very bad and that there has been hardly an evening that the service has not been interrupted from one to six times, varying in stoppage from 6 to 40 minutes; that repeated complaints to the company's office have met with promises, but no betterment of service, but, on the contrary, the service seems to be getting worse. The commission has asked the company to answer the complaint within 10 days.

During the present week the Public Service Commission, Second District, will give a hearing on the application of the Genesee Light & Power Company under section 69 of the Public Service Commissions Law for authority to issue capital stock; also, to the East Creek Electric Light & Power Company, under section 69, for authority to execute a mortgage upon all its property for $3,000,000 and to increase its capital stock from $200,000 to $750,000.

Non-Sparking Synchronous Commutating Machines.

In a patent issued on Nov. 16 to Dr. C. P. Steinmetz a description is given of a machine having interpoles without winding which operates sparklessly. The armature of the machine is of the closed-coil type provided with both a commutator and collector rings. The arrangement for operation is such that the



NON-SPARKING SYNCHRONOUS COMMUTATING MACHINE.

m.m.f. of the current entering by way of the collector rings is greater than that leaving by way of the commutator, and the excess m.m.f. serves for exciting the interpoles to the extent required for sparkless operation. This result is obtained when the machine receives all of its power over the collector rings and delivers only a part over the commutator, the remainder being utilized mechanically at the pulley.

Opening of New Physics Laboratory at University of Illinois.

With dedicatory exercises, held on Nov. 26 and 27, the new laboratory of physics of the University of Illinois, at Urbana, Ill., was formally opened. The dedication proper was held on the afternoon of Nov. 26, President Edmund J. James, of the university, presiding. With an appropriate speech, Gov. Charles S. Deneen, of Illinois, presented the building to the university. As president of the board of trustees, Mr. W. L. Abbott, of Chicago, accepted the building in a speech in which he pointed out that, as the university has no guaranteed income, its work must be extremely practical and kept close to the people to justify the Legislature in continuing to make sufficient appropriations to carry on the work of the institution. Some persons may think that this requirement would discourage abstract research work and college training where the prospect of immediate returns is not great. But the fact that a quarter of a million dollars was given by the Legislature for a laboratory of physics shows that the people of the State are willing to tax themselves to encourage the work of the institution.

President James delivered the charge to the department of physics, and Prof. A. P. Carman, professor of physics, responded in appropriate terms. Following this was the dedicatory address by President H. S. Pritchett, of the Carnegie Foundation for the Advancement of Teaching. One point in Dr. Pritchett's address was that while the college may be an intellectual and spiritual organism, it is still true that it rests for its success on some form of machinery of administration, and that the underlying principles which have to do with efficiency in the administration of a factory may be quite the same as those which have to do with efficiency in the administration of a department of physics.

In the evening there was a second meeting, with Dean W. F. M. Goss presiding, and the American Physical Society and the Illinois Academy of Sciences as guests. Addresses were made by Prof. David Kinley, dean of the Graduate School, and by Prof. Arthur G. Webster, of Clark University. On Nov. 27 there was a regular scientific meeting of the American Physical Society in connection with the formal opening of the new physics laboratory. An informal social gathering was held for guests at the University Club after the addresses at the evening meeting of Nov. 26, and there was also a luncheon for guests at the University Club after the morning exercises of Nov. 27.

Simple, but dignified and imposing, the new physics laboratory makes a notable addition to the engineering group on the campus. It is a stone-and-brick building of three stories, with basement and attic, and the cost of building and equipment has been $250,000.

The trustees of the university have approved the State architect's plans for a new building for general classroom purposes at the University of Illinois, for which the name Lincoln Hall has been suggested. The cost of this building will be $250,000, which was appropriated at the last session of the Legislature. Bids will be asked during the coming winter.

CURRENT NEWS AND NOTES.

BALTIMORE ELECTRICAL CONTRACTOR'S LICENSE CASE.—As recently reported in these columns, the right of the board of electrical examiners and supervisors of Baltimore, Md., to cancel an electrical contractor's license on the ground of alleged poor construction work has been challenged. Last week a contractor thus deprived of a license secured an injunction against the board on the ground that it had no authority to revoke the license after the work had been done according to the specifications and after it had successfully passed the inspection of the city officials.

CANADIAN WATER-POWERS.—In a recent report on the water-powers of the Ottawa and Gatineau Valleys, by Mr. Fritz Cirkle, it is estimated that there are available 306,020 hp on the Ottawa River, and 216,325 hp on the Gatineau River, aggregating 522,345 hp. The location of water-powers available for development are as follows: On the Ottawa, at L'Islet rapid on the Culbute channel, 2000 hp; Sabila rapids, 3800 hp; Timber Slide, 1400 hp; Garvin chute, 5000 hp; Cranfort rapids, 7000 hp; Black rapids, 57,000 hp; Muskrat rapids, 7000 hp; Rocher Frendu Chute, 5600 hp; Grand Calumet Falls, 25,000 hp; Mountain rapid, 13,000 hp; Dagis rapid, 4500 hp; Portage du Fort, 400 hp; Chats Falls, 50,000 hp; Deschenes rapids, near Ottawa, 35,000 hp; Skead's Mills, 25,000 hp; Chaudiere Falls at Ottawa, 70,500 hp; Black River Falls, 21,000 hp; Coulonge River Falls, 24,120 hp. On the Gatineau, six portages below Maniwaki, 2820 hp; The Corbeau, 5520 hp; The Boom, 4960 hp; Les Cedres, 3220 hp; La Passe, 210 hp; Le Bonnet Rouge, 875 hp; the Paugan Falls, 73,500 hp; The Cascades, 9000 hp; Chelsea rapids, 65,044 hp; Chelsea Falls, 50,400 hp.

KINGSTON (CAN.) ELECTRIC RAILWAY DISCONTINUED.—A unique situation has been created in Kingston, Can., by the shutting down of the local street-railway system, owing to the company and the city corporation having been unable to come to terms for the renewal of a contract for power for the railway. The company has been requesting the city to supply it with electric power at 1.20 cents per kw-hour for a term of five years, and stating that as it had lost money in the past and in order to make improvements to the system, it would require a contract for that length of time. The City Council, however, while agreeing to the price, would only consent to a three-year term, feeling that the increase in the demand of the city power service might necessitate the city increasing its plant, and it did not want to make a contract with the railway for any longer period. As a consequence, the street railway company shut down its service on midnight of Nov. 23 and the next day commenced to tear up the ties and rails, as well as to dismantle the substation equipment. The City Council, upon seeing the determination of the company, endeavored to take steps by way of injunction to stop the tearing up of the company's roadbed, but was advised by the city solicitor that according to the terms and conditions of the franchise the company had the right to remove its roadbed and equipment.

ELECTRIC USHER SERVICE.—In the Cohan Theater soon to be erected in New York use will be made of an electric usher call system connected with every seat so that a patron may call an usher by pressing a button.

PROPOSED FEDERAL REGULATION OF TELEGRAPH AND TELEPHONE.—Congressman Mann, of Illinois, who favors placing telegraph and telephone companies under Federal supervision, has had a conference with President Taft on the subject and suggested that a recommendation to that effect shall be included in the President's message.

N. E. L. A. COMMITTEE ON TERMINOLOGY.—The N. E. L. A. committee on terminology has asked the co-operation of the members of the Association in its work, and requested that they shall forward to it a list of such terms as in their judgment may require definition. The work carried on by this committee is similar to that which has engaged the attention of a British Sub-Committee of the Electrotechnical Commission of London.

THE TELEPHONE AND THE TELAUTOGRAPH.—A proposed use of the telautograph is under consideration whereby telegraph messages may be sent by wire to a telegraph office for final transmittal, thus superseding the present call boxes and messenger service. If public telephone offices become connected with the telegraph service, the messages would be sent to such offices also and thence transmitted to the outgoing telegraph message office.

NEW OFFICERS OF COMMONWEALTH EDISON BRANCH OF N. E. L. A.—By a letter ballot the Commonwealth Edison Branch, in Chicago, of the National Electric Light Association has elected the following officers: Chairman, Mr. John C. Manley; vice-chairman, Mr. E. O. Schweitzer; treasurer, Mr. W. A. Fox; secretary, Mr. O. R. Hogue; executive committee, Mr. George E. Burns, Mr. William M. Crane and Mr. H. C. Patterson.

INSURANCE RATES IN ILLINOIS.—The Policy Holders' Union, an organization recently formed in Illinois, is endeavoring to arouse the business interests of the State outside of Chicago to the necessity of some united action on the part of the assured toward securing a voice in the fixing of rates and insurance requirements. It is pointed out that under the present method these rates are made by one man without any consultation with the people who pay the premiums. Mr. George H. Holt is manager of the Policy Holders' Union.

BROOKLYN EDISON TO HELP BUILD THE FOURTH AVENUE SUBWAY.—Contracts have been signed by the Edison Electric Illuminating Company of Brooklyn with contractors engaged in the building of the Fourth Avenue subway covering over one-half of the tunnel route. The Edison company will not only supply energy for lighting the excavation work, but also for motors for hoisting, concrete mixing, temporary railroads and drilling. It is expected by the first of the year that active operation in the use of electricity along the excavation will be begun.

NATIONAL DISTRICT HEATING ASSOCIATION.—At the first annual convention of the National District Heating Association, held in Columbus, Ohio, on Nov. 10 and 11, the following officers were elected: President, Mr. A. C. Rogers, Toledo, Ohio; vice-presidents, Mr. J. H. Harding, La Porte, Ind.; Mr. H. W. Hillman, Grand Rapids, Mich.; Mr. F. E. Reidhead, Paducah, Ky.; secretary-treasurer, Mr. D. L. Gaskill, Greenville, Ohio. The exact date of the second annual convention has not been set, but it will be held at Toledo, Ohio, probably in the month of May, 1910.

TELEPHONES FOR RAILROAD MEN.—The Baltimore & Ohio Railroad entered into a contract for telephones in the residences of all of its employees in Cumberland, Md., whereby the railroad company is to bear the bulk of the expense, the men paying only about 50 cents a month for the service. More than 500 new telephones are being installed under this contract connecting the homes of every engineer, freight and passenger conductor, fireman, brakeman and member of the wrecking crews. It is reported that a similar plan will be put into effect at other Baltimore & Ohio Railroad centers, including Keyser, Piedmont, Grafton, Martinsburg and Brunswick.

BALTIMORE TELEPHONE WAR.—The Diamond State Telephone Company, the branch of the Bell Telephone Company operating in Maryland, has proposed to raise the price of its service, and the subscribers are retaliating in a most unexpected manner by preventing the company from erecting poles in front of their properties. A suit has already been instituted by a property holder claiming $2,000 damage for the planting of 17 poles along his property. The Maryland Court of Appeals several years ago rendered a decision to the effect that telegraph and telephone companies have no right to erect poles and string wires in front of properties without the consent of abutting landowners, notwithstanding that they have been given permission by the county commissioners.

INTERNATIONAL TELEPHONE CONVENTION.—At the annual convention of the International Independent Telephone Association, to be held at the Auditorium Hotel, Chicago, on Dec. 7, 8 and 9, papers will be read as follows: "The Insurance Exchange," Mr. J. D. Hoge, Cleveland; "Is the Telephone a National Monopoly?" Mr. Francis Dagger, Toronto; "Continental Telephone & Telegraph Company," Mr. M. G. Reynolds, St. Louis; "A Strong Financial Institution," Mr. E. H. Moulton, Minneapolis. In addition, there will be various committee reports and a "technical and operating conference" in charge of Mr. G. R. Johnston. Mr. Frank H. Woods, for the auxiliary committee, will discuss proposed changes in the organization and its constitution.

PERFORMANCE OF SMALL TRANSFORMERS.—Messrs. Antonio Guell and Hubert M. Turner have an article in the *Technograph*, the annual publication of the engineering societies of the University of Illinois, on "Tests of a 3-kw Transformer." The tests are of interest because the transformer is of the size much used in residence lighting and from employing the new alloy steel which gives low core loss. The efficiency was found to be 96.7 per cent at full load, 97 per cent at three-fourths load, and 95.7 per cent at one-fourth load. The voltage regulation was 2.1 per cent at 100 per cent power factor and 2.7 per cent at 60 per cent power factor. The exciting current was 2.34 per cent of the full-load current. The latter value is much below the manufacturer's guaranteed value of 3 per cent, and the core loss was 12 per cent below the manufacturer's guarantee. These results are attributable to the use of a voltage wave-form which differed considerably from the sine wave.

TRADE UNIONS FAVOR INDUSTRIAL EDUCATION.—At the recent convention of the American Federation of Labor in Toronto a special committee, of which Mr. John Mitchell was chairman, made a report on industrial education. The committee favors the establishment of schools in connection with the public-school system at which pupils between the ages of 14 and 16 may be taught the principles of the trades. It is recommended that the course of instruction in such schools should embrace English, mathematics, physics, chemistry, elementary mechanics, drawing, shop instruction and specific information in relation to the particular trade taught. The committee also recommends the teaching of "a sound system of economics, including and emphasizing the policy of collective bargaining." In order to keep such schools in close touch with the trades, there should be local advisory boards, including representatives of the industries, employers and organized labor. The committee recommends that as technical education of the workers is a public necessity, it should be not a private but a public function, conducted by the public and at public cost.

Generating Station of the Home Electric Light & Steam Heating Company at Tyrone, Pa.

THE new station of the Home Electric Light & Steam Heating Company at Tyrone, Pa., has many features of interest, and embodies the latest practice in design and construction, being a strictly steam-turbine plant operating condensing, and equipped with economizers and superheaters. The building is of concrete, steel and brick, approximately 80 ft. square, and is divided into boiler and engine rooms. The structure rests on 270 Raymond concrete piles driven to refusal, mainly in groups of four and six. These are capped with concrete on the ground, forming a rigid foundation upon which a solid concrete wall was built to a height of about 8 ft. from the surface of the ground, where the brick walls commence. The roof is very high, and is built of reinforced cinder concrete covered with Carey roofing. The coping, window sills, etc., are also made of concrete. The roof is supported by steel construction extending from the concrete substructure, and provision is made on the steel work for brackets to support the rails for a 15-ton traveling crane in the engine-room. Two floors are provided in the engine half of the structure, the lower or first floor containing the transformers for the rotary converter sets, the hot well and pumps, while the upper floor is reserved for the generating equipment.

Coal is brought to the plant on a concrete trestle 144 ft. long, connected with a spur track from the main line of the Pennsylvania Railroad. Under the trestle there is storage capacity for 2500 tons of fuel. The coal used daily is dumped into a concrete hopper on the trestle, and chuted thence to one-ton charging cars, which pass over an industrial track and scales to the front of the boilers. The ashes are also weighed and carried out at the other end of the building, and dumped into ballast cars for use on the railway line running between Tyrone and Altoona.

The boiler-room equipment comprises two 500-hp Stirling water-tube boilers, equipped with Foster superheaters, and operating at a steam pressure of 160 lb. An extra battery of Marietta boilers is kept in reserve. The smoke flue is built directly behind the boilers, and passes to the end of the building to a Green economizer, the products of combustion escaping in a concrete stack 175 ft. high and 8 ft. in diameter at the top. The steam piping, which was installed by the B. F. Shaw Company, is extra heavy and is equipped with Van Stone joints. Non-return valves are used on each boiler, in addition to the regular gate valves. A 12-in. steel header runs the length of the boiler-room parallel to the partition wall, from which curved-steel supply pipes lead to the steam turbines and the auxiliaries.

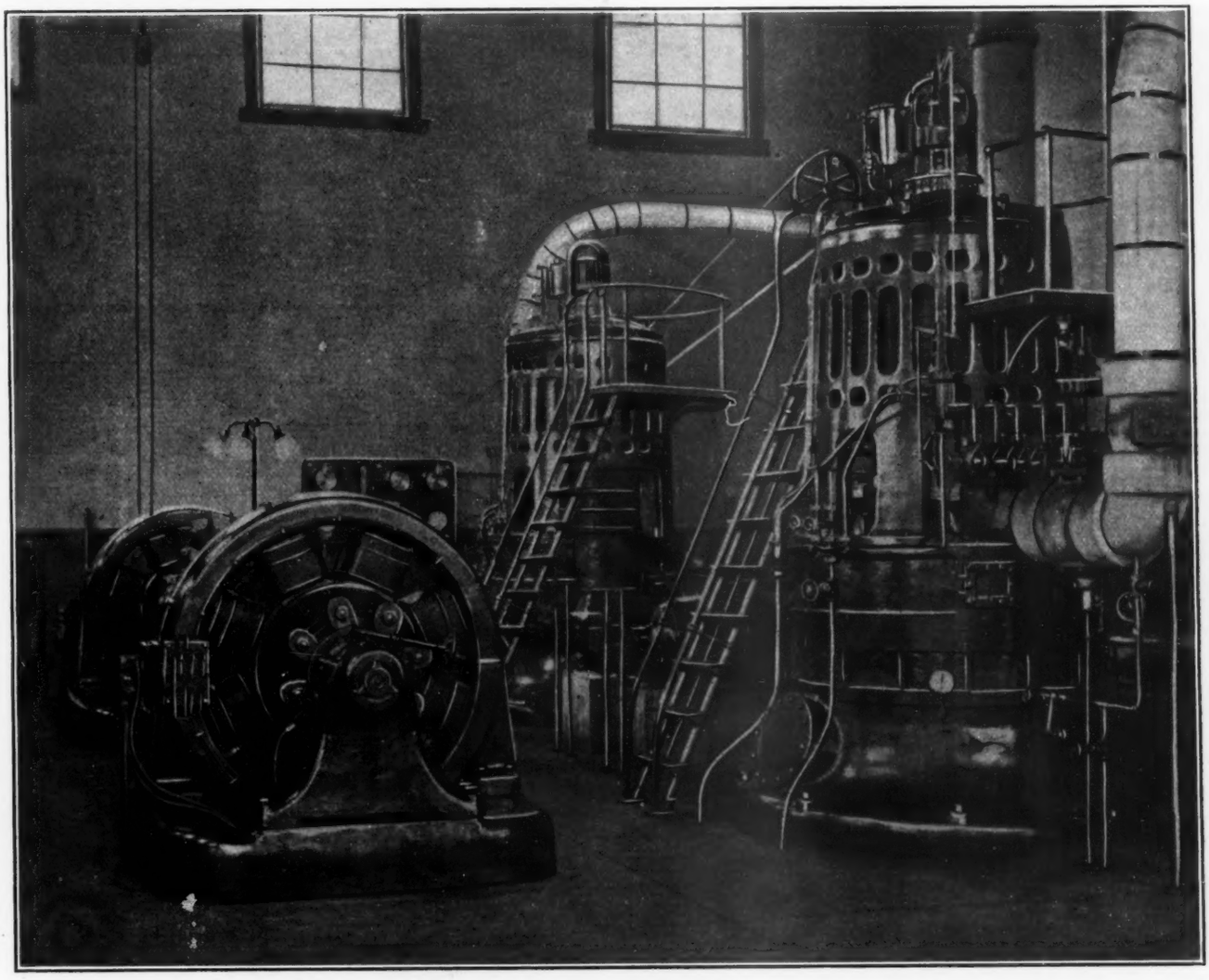


FIG. 1.—GENERAL VIEW OF GENERATOR ROOM.

The electrical equipment consists of two 500-kw, 2300-volt, three-phase General Electric turbo-generators; two 20-kw turbo-exciter units; two 300-kw, six-phase, 60-cycle, 600-volt rotary-converter sets; one 60-hp, 2300-volt, induction motor direct-connected to a 50-kw, 500-volt Western Electric generator

and three oil-cooled, 50-light, 4-amp General Electric mercury arc rectifier sets, besides the transformers for the rotaries. There are also in the plant a 30-hp, slow-speed, three-phase, 220-volt Western Electric induction motor driving a vacuum pump, and a 3-hp, three-phase Western Electric motor for the economizer scrapers. Energy for these motors is obtained from a bank of three 25-kw transformers in the basement. The 220-volt, three-phase circuits from these transformers are also carried out as a distributing line throughout the business section of the town, which is not far distant from the plant, so that all of the motor business adjacent thereto may be operated from one bank of transformers located at the plant, thus eliminating the losses due to small pole-line transformers for each individual installation.

The wiring from the switchboard is carried underneath the operating floor to the ends of the building, where it rises along the wall to a point near the roof. The wires are then carried at right angles to the wall 15 ft. over and dead-ended to a strain insulator on a steel beam. Eighteen inches above this beam is a beam at right angles and 20 ft. from the side of the building, to which the outside line wires are similarly dead-ended. Connection with the line wires is made by means of jumpers between the two sets of wires, so that it is possible to connect the feeders to any set of distributing lines by a few minutes' work inside the station.

The switchboard is of slate construction with ample room behind and in front, and with abundant natural light. The instruments on the board are all secondary. The switch handles of the oil switches are mounted on the face of the board, and the switches themselves on the iron framework at the rear of the board. In the center of the board are the two main generator panels, and on the right of these are the direct-current panels for the exciters, railway feeders, etc., and on the left are the alternating-current distributing panels. On account of the fact that the load on the plant is about equally divided between railway and lighting circuits, and the necessity for the use of a Tirrill regulator, it was found necessary to put in an auxiliary set of three busbars, from which the lighting circuits

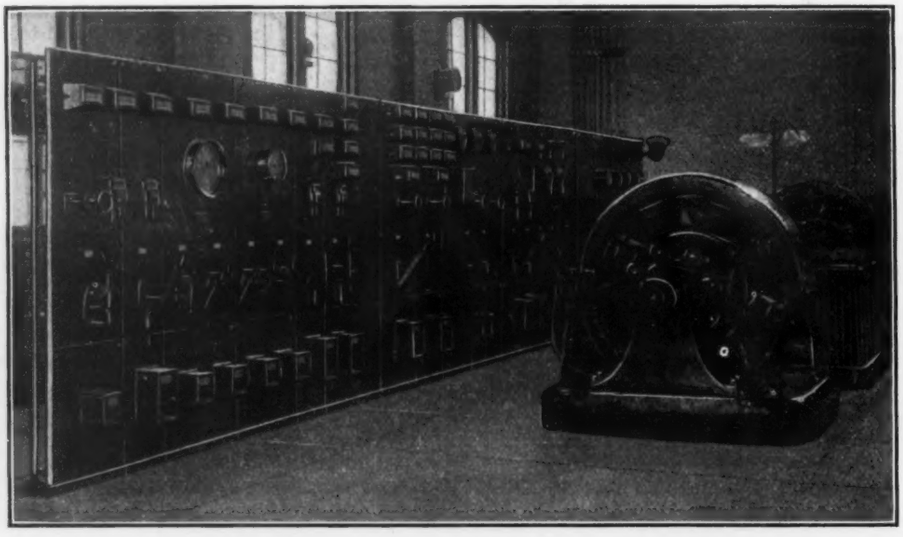


FIG. 2.—VIEW OF MAIN SWITCHBOARD AND ROTARY CONVERTERS.

are taken. The transformer for the Tirrill regulator is connected to the line between the main bus and the auxiliary bus, so that the regulation of the plant is maintained for the lighting load, and the Tirrill regulator does not compound for the increased load on the railway side, but only on the lighting side.

The incandescent circuits for Tyrone are carried on four single-phase lines, each controlled by a double-throw oil switch connected to two phases, so that the load may be balanced equally on both phases. A three-phase line extends the length of the town, and supplies energy for both lamps and motors to the Pennsylvania Railroad. A separate panel is used to control energy for the magnetite arc rectifiers, one of which is connected to each of the three phases. Each panel is equipped with an ammeter indicating the current flowing, and a watt-hour meter. Blank panels are placed in the main switchboard for a future third generator with its exciter. There are also

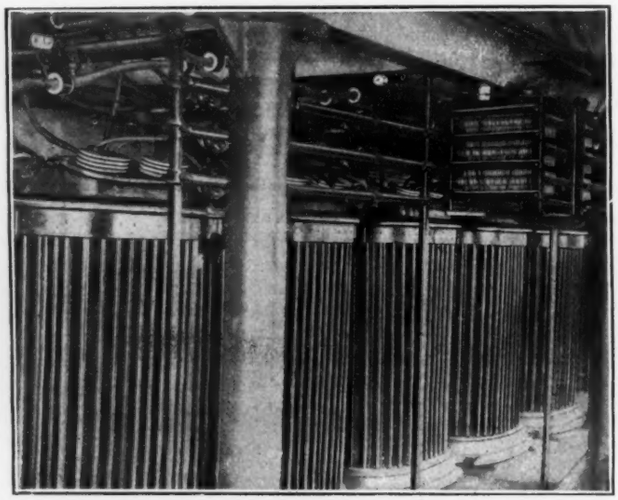


FIG. 3.—TRANSFORMERS FOR ROTARY CONVERTERS IN STATION.

blank panels for a booster and storage batteries for railway work, should these be found necessary.

The water supply for the station is obtained from a large spring located on Washington Avenue, about 900 ft. from the station. This spring furnishes an ample supply of water the year round at a temperature of about 52 deg. The water is conducted to an intake and dam along the railroad embankment adjacent to the plant, and from there conveyed by a 16-in. pipe under the embankment through a 52-in. iron-pipe culvert into the station, where it is used for condensing and other purposes. The condenser is of the barometric type, built by the Alberger Condenser Company, and is placed on the roof. With inlet water at a temperature of about 52 deg. a vacuum of approximately 27.5 is maintained, the discharge water having a temperature of about 80 deg. A centrifugal circulating pump, built by the Janesville Iron Works, and connected to a Terry steam turbine rated at 60 hp, and running non-condensing, pumps the water for the condenser. The boiler-feed pumps were also supplied by the Janesville Iron Works. Water for boiler-feed purposes is taken from the hot well at between 80 deg. and 90 deg., and passed to a Cochrane feed-water heater, leaving this at a temperature of about 210 deg. It is then pumped through the economizer to the boilers. The temperature of the water when leaving the economizer varies from 300 deg. to 340 deg. By means of a Foster superheater the steam is heated to an average temperature of between 480 deg. and 490 deg. The wiring in the plant is all flame-proof and heavily insulated, so that it may be carried exposed on rack insulators. Lightning arresters are placed on the wall and underneath the outlet for the wires. A small air compressor for supplying air for cleaning the machines is installed in the basement.

The plant was designed and the construction superintended

by Mr. A, S. Kibbe, engineer of the American Railways Company of Philadelphia. The operating force consists of a chief engineer, two operating engineers, two firemen and a helper. The equipment is operated continuously, giving a 24-hour service for general lighting and power work, and also supplying energy to the street railway company. The station was placed in operation July 1, 1908, and has met the expectations of the

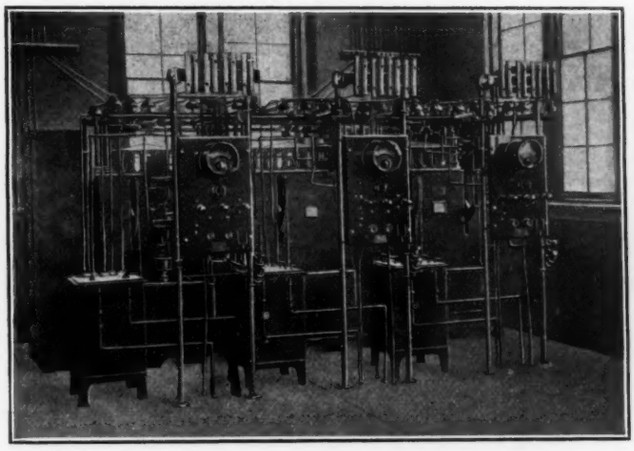


FIG. 4.—MERCURY RECTIFIERS FOR MAGNETITE ARC SYSTEM.

designing engineer for economical operation and maintenance. Bituminous coal, obtained about 20 miles from the station, is used. This fuel is a fair quality of run-of-mine, and full-load tests on the station show that when operating one turbine at full load the coal consumption varies from 3½ lb. to 4 lb. per kw-hour output, including the steam used by the auxiliaries. A Venturi meter is used on the boiler feed-pipe. Records are kept by the chief engineer of the kw-hour output on the turbines, the coal burned, the ashes, together with the water evaporated by each fireman on his shift, so that it is a matter of a few days only to determine whether a fireman is working economically or not. Ample provisions have been made for the comfort and welfare of all employees, who are provided with individual steel lockers, shower baths, toilet-rooms and wash-rooms.

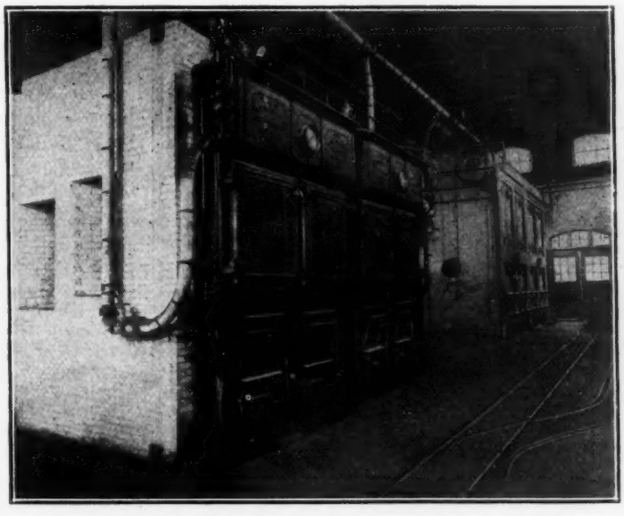


FIG. 5.—VIEW OF BOILER-ROOM.

The Home Electric Light & Steam Heating Company does a general lighting and power business in Tyrone, besides furnishing energy for the Altoona & Logan Valley Street Railway, connecting Tyrone and Altoona. In addition the company supplies 75 4-amp General Electric magnetite arc lamps for the Borough of Tyrone, and 40 lamps of the same type for lighting the yards of the Pennsylvania Railroad Company, together with energy for lighting the shops and operating such motors as the railroad company has. The company also operates a substation at Bellwood, about eight miles from Tyrone, which supplies energy for 50 4-amp, 50-watt, tungsten series lamps, 15 magnetite arc lamps and commercial lighting circuits. The line is carried from Tyrone on the poles support-

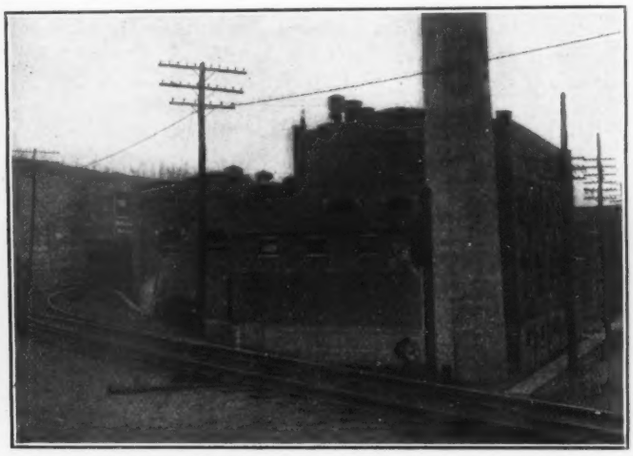


FIG. 6.—EXTERIOR OF STATION SHOWING COAL SIDING.

ing the trolley wires, and is operated at 2300 volts, the booster in the power plant being pressed into service at times of heavy load. Three-wire, 110-220-volt, secondary distribution is used in Tyrone for lighting circuits. The company also operates a sign circuit which is turned on and off from the station, the nearness of the business part of the town to the station making this quite feasible. The sign circuit is switched on from dusk to 11 o'clock, and to it are attached numerous signs and considerable outline business, aggregating 1000 6-cp lamps. The company finds it possible to obtain business for this service which could not be obtained on a meter basis. Although the income is practically the same per kw-hour, the merchants appear to be more willing to pay a flat rate for the sign and outline lighting than to have this business fed through meters.

Most of the street lamps in Tyrone are hung from two poles

FIG. 7.—SPRING USED FOR BOILER FEED AND CONDENSER PURPOSES.

with Cutter pulleys on 5/16-in. galvanized iron span wires, Oneida galvanized chain being used for raising and lowering the lamps. The magnetite arc system has been in use for over three years, and has been very satisfactory. All of the customers, aside from those on the sign and outline circuits, are supplied on a meter basis, and the meters are inspected and tested

in the shop at least once a year—the larger meters at shorter intervals. Considerable success has attended the residence lighting business in Tyrone, which amounts to more than the connected load in the business district, and a fair income is derived from this source. Much of the success is due to the installation of electric flatirons and the tungsten lamp, both of which the company offers every inducement to install.

The American Railways Company, of Philadelphia, owns the station. Mr. S. S. Crane, Altoona, Pa., is general manager, and the superintendent at Tyrone is Mr. W. R. Power, to whom much of the operating success of the station is due. Mr. F. W. DeMart is chief engineer. The executive officers are: Mr. J. J. Sullivan, president; Mr. H. J. Crowley, vice-president and general manager; Mr. C. L. S. Tingley, secretary-treasurer, and Mr. F. J. Pryor, comptroller.

Underground Distribution for Small Cities and Towns.

By J. Franz.

THE demand for underground distribution is growing every day, not only in congested cities, but also in suburban districts and residence country towns where it is undesirable to mar the beauty of the streets with pole lines. No doubt many central stations are requested by patrons to eliminate overhead wires or are refused grants for further extensions. In cities where consumers are not widely scattered, the central station is often very willing to make a change from pole lines to substantial underground distribution wherever the business warrants the large initial cost. The writer will describe a system which has given very satisfactory service for the past 12 years in a residential town.

A trench 1 ft. 6 in. x 2 ft. deep will be ample for two ducts. The bottom should be graded and a fall of 3 in. to 100 ft. will give the ducts sufficient drainage. On sloping ground no grading will be necessary. Such a trench can be quickly excavated where the digging is fair. Fiber ducts with socket joints will be found most serviceable for this work. The additional cost compared with that of other duct material is compensated for by its lightness, which means reduced freight and cartage charges and practically no breakage. It can be laid very rapidly, and

FIG. 1.—WRAPPING TAR PAPER AT JOINT.

comes in sections 4 ft. 6 in. to 7 ft. 6 in. in length. The joint (Fig. 1) is made by wrapping the butted ends with a piece of tar paper 12 in. x 4 in. dipped in boiling tar or asphalt, which, when properly made, will be water and gas tight.

Some manufacturers recommend making the joint by simply dipping the ends of the duct into the tar; this has not been found advisable by the writer, as the workmen usually dipped the ends carelessly, which resulted in a quantity of undesirable tar getting inside the duct. Another advantage of fiber duct is its high insulating qualities, and it is claimed to be electrolysis proof.

In the system the writer refers to, the fiber duct has been in use for about six years; previous to this cement-lined pipe was laid and the many advantages of the fiber duct was experienced.

If a No. 10 or No. 12 galvanized-iron wire is drawn in the duct while it is being laid it will save time and expense of rodding. The wire will also answer to pull in the cables, weighing as high as 2 lb. to a foot, on sections up to 350 ft.; for larger cables a rope will have to be pulled in with the wire and the cable afterward pulled with the rope. If the wire is handled with a little care it can be used many times over.

When duct is laid on highways or other places where it is

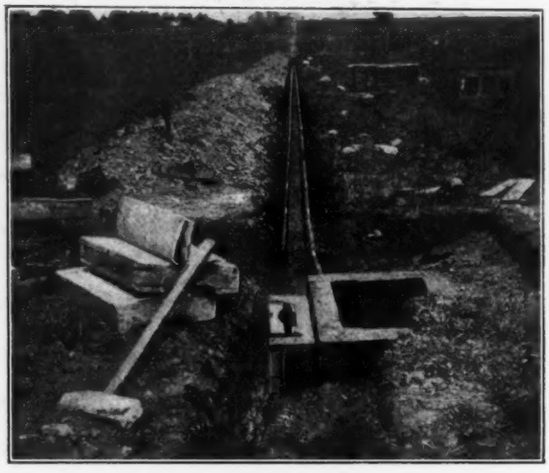


FIG. 2.—CONNECTION TO RESIDENCE.

apt to be disturbed it is well to protect it with a covering of six-to-one concrete about 3 in. thick. By hilling the dirt on each side of the duct very little concrete will be necessary, and the covering will be strongest where most needed. Manholes should be located at all angles and wherever branches are taken off, and should not be spaced over 300 ft. or 400 ft. apart.

It is desirable to run all ducts as nearly in straight lines as possible, although wherever minor obstructions, such as water pipes, sewer manholes, etc., are encountered, a slight sweeping bend will not be objectionable. The manholes can be made of concrete, measuring 24 in. x 36 in. x 24 in. deep, having a 6 in. wall. Such a manhole is sufficient in size for two ducts, and can be covered with any suitable cover of iron or stone or cement. The writer has used cast-iron plates ½ in. in thickness.

The manhole must set deep enough so as to allow about 1 ft. of earth covering on top of the plate. They should be marked with a monument or other prominent marker. In some cases the marker may have to be set some distance from the manhole, in which case the distance should be engraved on its face. Such manholes cannot be as readily opened as those with surface covers, but considering that they do not have to be opened very often, will be found quite practical for the purpose. Indeed, on macadam roads or in lawns even surface manholes become completely covered in a short time. Such roads are continually resurfaced and in such cases manholes might just as well be of the type described.

Drainage of conduit systems is a consideration for each particular locality, but in general it may be said, where the soil is dry, no draining will be necessary, the covered holes will allow little water to get into them, save what will soak through the earth. Where the soil is wet, the manholes should be drained as often as possible, as it is not well to use conduits as waterways. It may be of interest to mention that the writer has installed ducts in very wet places where absolutely no draining was possible, without experiencing any trouble from freezing. This may be laid to the fact of the fiber duct expanding rather than pinching the cable under the pressure of the expanding ice.

Wherever ducts enter houses they should be sealed. Flexible

roofing cement will be found best suited for this purpose. It makes a tight plug, does not affect the lead, will not harden and can be easily removed when necessary without injuring the lead sheathing of the cables. Very often the question of ventilation of a conduit system presents itself, but the writer in his experience has never found any necessity of making any provision for ventilation in the systems installed.

Fig. 2 shows the work under construction where a 3-in. and a 2-in. pipe are being laid to a residence. The larger pipe is used for a 2400-volt, single-phase cable and the small one for a telephone cable, the telephone company requiring 8-in. separation between ducts and separate manholes.

Below is given the cost of such a system as averaged on a four-mile, double-duct line with concrete cover and a two-mile single-duct line with concrete covering.

COST PER 1000 FT. OF LINE.

	Double duct.	Single duct.
Labor installing conduit at $1.75 per day	$120.00	$100.00
Labor putting in cable and making joints	37.00	25.00
3-in. fiber conduit at 6½ cents per ft.	130.00	65.00
No. 6 twin lead-covered cable at 12½ cents per ft.	251.00	.....
No. 10 twin lead-covered cable at 11 cents per ft.	.....	110.00
Gravel delivered at 70 cents per yd.	14.00	14.00
3 iron manhole covers 28 in. x 40 in. x ½ in.	9.00	9.00
3 marble markers 6 in. x 6 in. x 28 in.	3.30	3.30
Cement at 50 cents per bag	10.00	10.00
Teaming, general expenses, etc.	25.00	20.00
	$599.55	$356.30

Where street lighting is to be considered, the above costs will be approximately the same; each extra manhole may add about $18 to the costs and lamp posts can be purchased for reasonable prices. The writer has used a post which cost $18 without hood and fittings. It consists of a cast-iron base with a 3-in. steel tube reduced to 2½ in., and a crook with the necessary cast-iron trimmings.

There are also other expenditures, such as installing switches, etc., on long lines. Looping the cables into a suitable vault will be found a wise investment as it helps toward satisfactory operating conditions.

In the writer's experience the consumer bears all the expense of conduits and cables installed on his property and also for the transformer vault. Very often if he is approached properly he is also willing to pay quite a sum toward building an underground line to reach his residence rather than see overhead construction mar the natural beauty of his surroundings.

Depreciation as an Element of Rate-Making.

A decision rendered recently by the Railroad Commission of Wisconsin, in response to a petition filed by the citizens of Marinette alleging that the Wisconsin Telephone Company charged excessive and unreasonable rates, is based in part on the element of depreciation of the plant. In this case a valuation of the physical property of the company was made by the engineering staff of the commission, and an analysis made of the earnings and expenses with consideration of the question of the rate of return. Various other elements which were taken into consideration in the decision of the commission are the subjects of intangible values, going value and the existing rates. It was shown in this case that the Marinette plant, without including anything for intangible values, had been earning an average of 9.1 per cent on the estimated inventory investment, and 8.18 on the book cost. In the judgment of the commission it was better public policy to leave the present prosperous condition of the Marinette exchange undisturbed for the time being, and to watch closely future operations.

The valuation of the physical property of the Marinette exchange, under the direction of the commission, established a value as of Dec. 1, 1907, of $67,738. This was $219 less than the value placed upon the plant by the engineers of the company. The valuation included an allowance of 10 per cent for superintendence, interest during construction and contingencies upon all of the items of physical property excepting stores and supplies. In this valuation the life and scrap values used by the engineers of the commission were as follows:

	Life.	Scrap.
Cedar poles and cross-arms	12 years	0
Iron wire	10 "	0
O. H. lead covered cable	15 "	4c lb.
Switchboards	12 "	20 per cent
Copper wire	20 "	75 " "
Subscribers' sets	10 "	5 " "
P. B. X. boards	10 "	5 " "
Distributing wire	10 "	15 " "
Storage battery	15 "	5 " "
Motor generator, etc	20 "	20 " "

The foregoing data are discussed in the report, which states that the five leading authorities in this country are unanimously in favor of a 12-year allowance for wooden poles. Some difference of opinion existed regarding the life of iron wire, but 10 years represented a fair average. Originally the life adopted for aerial cable was 15 years, but this was reduced to 12 years after a consideration of the opinions of engineers connected with both Bell and independent companies. The life of power plant and storage batteries was adopted as eight years, after considering various data.

Since this valuation was completed additional data have been gathered by engineers of the commission, and the average composite life has been reduced from 12.44 years to 11.13 years. As the former life was assumed in the physical valuation, there would necessarily be a revision in the value of the plant in its present condition, although the estimated cost of reproduction new would remain unchanged. The life of 11.13 years necessitated an annual depreciation reserve allowance of 8.98 per cent, assuming that the fund would earn no interest, and 7.32 per cent if it is assumed that the fund would earn 4 per cent annually.

The company charged for current repairs and reconstruction on its entire business in Wisconsin in 1907 the following percentages of the cost of plant and equipment as they stood at the close of the year: Exchange system, 4.6 per cent; toll system, 2.7 per cent; entire system, 4.1 per cent. According to the practice of the company, if the appropriation made in advance from earnings to cover present and deferred reconstruction is inadequate, the excess expenditure is charged to the reserve fund remaining from previous periods and the balance unexpended in a given period is credited to reserve. It was figured by the commission that the company was charging itself about 5 per cent annually for depreciation. If the depreciation fund is invested and a rate of return thereon from 9 to 10 per cent is assumed, the amounts charged by the company for depreciation would reach the level which the figures of the engineers of the commission show should be charged in order to meet the requirements of the law respecting depreciation. While the past practice of the company and the computation of the commission suggest a rate of depreciation varying from a little over 5 per cent to about 9 per cent, dependent upon the rate of interest, if any, which the fund would earn, the president of the company and two of the chief experts who testified suggested a higher rate.

Mr. Alonzo Burt, president of the company, during the hearing of the case, defined depreciation as the allowance that must be made for replacing apparatus on account of wear and tear, unforeseen changes in the state of the art, or increase in the traffic, which outgrew the equipment and necessitated replacement with larger and more nearly adequate apparatus. Practically no piece of apparatus lived its natural life. An experience of the company in Green Bay had illustrated how a corporation may be required at any time to replace or reconstruct parts of its equipment on account of legislation. By making allowance for all of the elements that entered into the depreciation of telephone plants—obsolescence, inadequacy, public requirement and casualty—Mr. Burt fixed 10 per cent as a proper ratio for depreciation to constitute an annual reserve for maintenance and reconstruction, over and above any allowance for current repairs. The average life allotted to various portions of the equipment by the valuation staff of the com-

mission was too long. The suggestions of Mr. Burt were:

Subscribers' instruments: Ten years is too high by fully two or three years. Few subscribers would accept second-hand or shop-worn instruments.

Cedar poles: City poles are shorter lived than those in the country by at least several years.

Cables: Taking a whole plant into consideration, the quantity that would remain after 15 years of service was very small.

Switchboards: The ordinary life was from six to eight years, based upon actual experience in a large number of plants. Changes in the state of the art, difficult to foresee, were usually potent factors in determining the depreciation of the equipment.

Copper wire: Twenty years of life, with a salvage of 75 per cent, was only a remote possibility and not an average. The chances were that with the growth of the business the wires would come down and cables go up before 20 years had expired.

Storage batteries and motor generators: The life of the storage batteries and motor generators was from seven to eight years; the experiences of the New York and New Jersey telephone companies indicated these figures. Motor generators and batteries may live somewhat longer than eight years, but they usually became too small to supply the current necessary for the community. The experience of New York was that under ideal conditions some machines had given service for about 10 years.

Mr. George Wilkinson, certified public acountant, defined depreciation as a loss in value of the destructible property of a telephone plant over and above what was covered by current repairs. The allowance should protect against losses from wear and tear, obsolescence and inadequacy. Land and buildings excluded, 10 per cent on the diminishing value of the destructible property used to create earnings was a proper allowance.

Mr. W. F. Burgess, an English telephone expert, defined depreciation as a loss in value. Any construction or replacement which was added to a plant without increasing its value was properly chargeable to the reconstruction fund.

The loss in value might be occasioned by various causes: 1. The wear and tear incident to a plant living its natural course of useful life. 2. The necessity of replacing a plant by a plant of larger capacity. 3. Legislation regulating construction and necessitating the removal of certain parts to make way for prescribed improvements. 4. Storms, wind, etc., the acts of God. 5. Changes in the state of the art.

Great importance was attached by this witness to the last mentioned cause, to which he ascribed the greatest loss in value. New inventions and improvements necessitated revolutionary changes in installations and methods after comparatively short periods of time. He had been employed on one improvement for which the Chicago Telephone Company expended $340,000 in experimentation at its Lake Forest exchange. Mr. Burgess reached the following conclusions:

Exchange equipment: The largest item was the switchboard, which practically had a life of only eight years. The scrap value was only about 3 per cent. The rapidity with which old batteries and generators were outgrown would lead to an average life of but seven years.

Poles and cross-arms: The average life of a city pole in Chicago was about eight years. In places of 15,000, the size of Marinette, an additional year might be allowed. More overhead equipment was carried on the poles at Marinette than in Chicago, and this made the wind resistance greater. The liability of legislative direction to remove poles must be taken into consideration.

Wire plant: Fifteen years was suggested for this portion of the equipment, with a salvage value of 60 per cent for aerial cables. Drop wires were less valuable.

Aerial cables: These were good for 11 years. Buildings and real estate were considered as practically indestructible property.

Refrigeration and Electricity Generating Stations.

By Sydney F. Walker.

COLD storage and ice making is developing very rapidly in nearly every part of the civilized world. In the United Kingdom, every town of any size has its own cold-store, and every large town has several. In addition, butchers, poulterers and fish-dealers, who have much business, now have their own cold-store. In all of these, the electric drive should be the most convenient. In the first place the electric motor is a far more satisfactory apparatus to drive a refrigeration compressor than is either a steam engine or a gas engine. In the case of the steam engine, it will be remembered that if the engine is to work economically the cut-off must be early, and the force delivered to the piston gradually decreases in value from the moment of the cut-off to the end of the stroke. On the other hand, the resistance opposed to the piston, by the compressor, increases in value up to the moment when the outlet valve opens, about the middle of the stroke, or sometimes a little later. With an electric motor the force delivered by the axle of the motor is the same at every part of the stroke of the compressor piston. Like the steam engine, the gas engine is also at a disadvantage compared with the electric motor. As is well known, the whole of the energy utilized by the piston of the gas engine is delivered to it during the very small interval covered by the time of the explosion, and a very short period after. From the end of this period to the next explosion, though the rate of delivery of energy is equalized to a certain extent by the flywheel, the force on the piston continually decreases.

Notwithstanding the above facts the electric drive has not yet made much headway in the United Kingdom. There are several reasons for this. One reason, the writer believes, is that the generating stations so far have not been able to get down to the price at which energy can be obtained from steam, or from the suction gas producer. In a great many towns, also, the cost for service by the electric motor is greater than that of a similar service delivered by the town's gas. The greater convenience of electricity would, and will lead, the writer believes, to its greater adoption for driving compressors, as time goes on, and as the publicity departments of the different towns get into operation. Up till recently, the electricity generating stations have not taken very much trouble to look out for business. The keen competition which gas introduced during recent years, especially for lighting, is now obliging electricity managers to look out more for business, and the usual results will doubtless follow.

Another reason for the use of steam instead of electricity, in the case of firms which make ice as well as run cold-chambers, is the fact that the condensed steam, when properly purified from oil, etc., is conveniently employed for making ice. It is usual in ice-making plants, where condensed steam is not employed, to distil the water that is to be converted into ice, and it is also put through a very careful process of purification, to eliminate every injurious substance. It is claimed to be one of the great advantages of manufactured over natural ice, that one cannot tell what injurious substances may be present in natural ice, unless very great care has been taken in watching the streams, etc., from which the ice has been cut.

There is still another reason for the use of steam rather than electricity, namely, the usual difficulty of overlapping. What central-station managers want most is a load that will come on when the peak is not on, and one of the greatest difficulties in providing this load is, as the writer understands it, the fact that nearly all those who require energy during times of small load, also require it during the peak times, and, therefore, the central-station engineer is really not much benefited, because he must provide more equipment to meet the addition during peak time.

In addition to the above, the writer has met with complaints from refrigeration engineers on the one hand, that electric motors rated at a certain number of horse-power would not

carry the load corresponding to this rating. On the other hand, cold-storage managers who are not makers of refrigeration plants, complain, very justly, that makers of refrigeration plants often very much understate the power that is required for driving their compressors. The understatement is unfortunately one that is somewhat common in a great many industries. Agents are too apt, when trying to secure an order, to claim all kinds of things for their apparatus. When a firm is installing a cold-storage plant, and is counting the cost, the question of service naturally comes up, both in the first cost of the apparatus that is to furnish the service, and in the cost of maintaining the service. Naturally the apparatus which is said to use the smallest amount of power is apparently the cheapest, but as a cold-storage manager recently bitterly complained to the writer, the power stated to be required by the compressor is really that required during the most favorable portion of the year. As will be explained later, the power required by the compressor depends upon the temperature of the cooling water available for the condenser. The higher the temperature of the cooling water, the greater is the power required to be delivered to the compressor. Hence, if a compressor has been tested with cooling water at, say, 50 deg., and the only cooling water available is 70 deg., the power required by the compressor is considerably increased.

In the case of either a central-station engineer, or a contractor supplying an electric motor, unless he is familiar with the requirements of a refrigeration plant, and can estimate the power required under all conditions, and can also ascertain the conditions that are likely to rule during the time that the plant will be most worked, namely, during the summer months, he is very apt to be subjected to much contention. Something of the following may easily happen: A central-station engineer, or a contractor, may be asked to supply a 20-hp motor. When the motor is arranged to drive the compressor, it is found that 20 hp is not sufficient. At any rate, the motor will not run the compressor as it ought to be run. The compression is not complete, and a part of the gas in place of being condensed passes over as gas, and considerably reduces the efficiency of the whole plant, and lessens the work done. The cold-storage manager at once turns to the man who supplies the motor, and insists that the motor is at fault. Everyone who has been through trouble of this kind knows how difficult it is to convince the buyer of the motor that the motor is not at fault. The buyer knows nothing about the measurement of power. If a transmission dynamometer is set up, he will not believe that the indications it gives, when worked out, show that the motor is developing the power that has been claimed for it, and everyone who has attempted to do so knows the difficulty in setting up any efficient testing apparatus under such conditions. The current and pressure delivered to the electric motor are, of course, a guide to a certain extent, but the buyer, or whoever might be advising him, might easily retort that the efficiency of the motor was low. The real trouble has not been with the motor, but that the cooling water being of a higher temperature than that at which the maker of the refrigeration plant tested his apparatus more power is required.

CALCULATION OF POWER FOR REFRIGERATION.

There are two distinct duties performed by refrigeration firms, namely, the making of ice, and the holding of chambers at a low temperature for the storage of produce. Ice making, as will easily be understood, is confined almost entirely to the summer months. The cold storage goes on throughout the year, but it demands less power during the winter, for the reasons explained below, than during the summer. The two duties differ in their requirement of power, apart from the fact that ice making does not go on in the winter, from the fact that while it can be arranged to take power for cold storage at practically any time that is convenient to the central-station engineer, the power required for ice making must be continuous. Ice is made in various forms, in cans of a slightly pyramidal shape, giving the blocks that are seen in fish-dealers' shops; in plates, and in sheets. In all forms, the action of cooling must be continuous, or the ice would be laminated, and there would be a considerable increase of cost in making the ice. The time required for turning out the ice ranges from 20 hours upward. So that where ice is made the overlapping mentioned in a previous part of the article necessarily takes place.

With cold-stores only, it is possible either to arrange for the temperature of the store to be reduced by a few degrees below the normal working figure, before the time of peak load, or to have a store of cold brine which will be cooled during convenient times and will keep the store below a certain temperature between times of working the apparatus. This last arrangement is generally adopted by tradesmen, butchers, poulterers, etc., who have their own refrigerating plants. The cold chamber is reduced to a certain temperature on Saturday night, and in addition, a store of brine is also reduced to a certain temperature, and the whole thing is left until Monday morning.

The demand for power by cold-stores, however they may be working, is greater in summer than in winter, for another reason; the amount of power required to drive the compressor, which is by far the principal power user in a refrigeration plant, depends directly upon the difference of temperature of the gas at the suction and at the delivery valve of the compressor. The temperature at the suction valve is the temperature to which the gas is reduced in the process of cooling the chamber, and depends upon the temperature at which the air in the chamber is held, or, as explained below, upon the temperature of the brine. The temperature at the delivery valve of the compressor depends upon the pressure to which the gas has to be raised, and this again depends upon the temperature of the cooling water. The gas is condensed by two operations, compression, drawing the molecules of the gas closely together, and the deprivation of their latent heat. Obviously, the temperature at which any given cooling water can extract heat from a gas, and leave it in the liquid state, is higher than the temperature of the water itself. It is usually assumed that the temperature of the gas when liquefied, and the temperature of the liquid is about 10 deg. higher than that of the cooling water. There is a corresponding pressure for every temperature of the gas, and consequently as the temperature of the cooling water rises, so does the pressure at which the gas is liquefied, and the pressure to which the gas has to be raised. An illustration of this relation will perhaps make the matter clear. With cooling water at 55 deg. Fahr., the temperature of the gas as it is liquefied would be about 65 deg. Fahr., and the corresponding pressure for ammonia is 103 lb. per square inch. Taking again a temperature of 5 deg. Fahr. in the gas which has done its work in cooling the chamber, the temperature of the gas at the suction valve as 5 deg. Fahr., the power required to furnish a "ton of refrigeration" (per day) is about 0.66 hp. With cooling water at 90 deg. Fahr., and the temperature of the gas at the delivery valve 100 deg. Fahr., the pressure is 200 lb. per square inch, and the power required per "ton of refrigeration" is about 1.15 hp. Carrying the matter a little farther, if the temperature of the gas at the suction valve is reduced to minus 5 deg. Fahr., the power required when the cooling water has a temperature of 55 deg. Fahr. is 0.8 hp, and that required when the cooling water is 90 deg. Fahr. is 1.33 hp.

The figures taken above, 5 deg. Fahr. as the suction temperature of the gas, is about the usual temperature for holding cold chambers at a temperature of 15 deg. Fahr., which is a common figure when the chamber is cooled by what is termed "direct expansion"—that is to say, when the grid of pipes carrying the expanding gas is fixed in the chamber to be cooled.

As is well known, there are three principal substances employed in refrigeration plant—ammonia, carbonic acid, and sulphurous acid. Ether and other substances are occasionally used. Whatever the substance, it is alternately compressed, condensed to the liquid form, and allowed to re-expand to the gaseous form, again compressed and condensed, and so on. In every refrigeration plant there is a complete circuit, consisting of the compressor which is really a pump, the condenser which is similar to a steam condenser, and what is termed the evaporator, consisting of a grid of pipes, in which the liquid is allowed to assume the gaseous form. In assuming the gaseous

form, it demands the necessary latent heat from surrounding bodies, and so cools the produce, the chamber, etc.

There is another method of cooling that is very largely employed, particularly in stores, namely, by the aid of brine. In place of fixing the evaporating coils in the cold-store, they are placed in a tank through which a solution of a salt, usually calcium chloride, is kept continually circulating. There is a grid of pipes fixed in the cold chamber, or in the ice tank when it is used for making ice, and the brine is kept continually passing through the grid of pipes, through the evaporating tank in which the evaporating coils are placed, and back to the grid of pipes again. As the brine passes through the pipes in the cold-store, or the ice tank, it extracts heat from the air, or the water, and as it passes through the evaporating tank it delivers the heat to the gas in the evaporating coils, thereby causing the gas to expand, just as when in the cold-store. Brine is employed in cold-stores, in preference to direct expansion, because in the case of ammonia, at any rate, if any of the gas escaped, the produce would be tainted. It should be noted, however, that when brine cooling is employed, additional power is required. A small amount of power is absorbed by the brine pump to keep the brine in circulation, and in addition, the gas must be allowed to assume a lower temperature than when direct expansion is employed. It is usually assumed that the brine coils must be at a temperature 10 deg. Fahr. below the surrounding atmosphere, and the evaporating coils 10 deg. below the brine—hence the additional power. In the second set of cases given above, where the suction temperature of the gas was taken as minus 5 deg. Fahr., brine cooling was allowed for.

There is yet a third arrangement, which is very largely employed at the present time, namely, cooling the air which passes through the chamber by passing it over a grid of brine pipes or a grid containing expanding gas. With this arrangement there are no pipes in the cold-store, the whole of the cooling being performed by the continued passage of the cold air through the store. The air is dried at the same time as it is cooled, and this method has a great advantage in the case of some kinds of produce. With this arrangement, a still further increase of power is required. Thus, the temperature of the air must be a few degrees lower than that of the produce carried in the store. The brine must be 10 deg. below the temperature of the air, and the gas 10 deg. below the temperature of the brine. In addition, power is required for driving the fan that circulates the air.

The standard allowance made for power for a refrigerating plant is taken at from 2 hp to 2.5 hp per "ton of refrigeration." The writer would advise any electrical engineer who has to supply power for a cold-store to make a still larger allowance, more particularly if the plant is working in hot climates. Cooling water has been found to vary as much as from 45 deg. Fahr. up to 105 deg. Fahr.

It will easily be understood from what has been said above that a store of brine can be placed in a cold chamber, and its temperature reduced to any value that may be desired, so as to allow for the plant being at rest for any given number of hours, say, during the peak load, or from Saturday to Monday.

THE "TON OF REFRIGERATION."

The term "ton of refrigeration" as used above should be explained. It is the term employed by refrigeration engineers to express the amount of cooling that a given plant will supply. It is taken from the cooling effect of a ton of ice spread over 24 hours. In America a ton of ice weighs 2000 lb., and as each pound will absorb 142 heat units in melting, the total heat absorbed is 284,000 thermal units. This effect is spread over 24 hours, so that the cooling effect produced in one hour is about 11,700 thermal units, and in one minute 1950 thermal units. The "ton of refrigeration" term is apt to be a little puzzling to those who see it for the first time. It is only when the fact is realized that the total cooling effect is spread over the 24 hours that the unit is properly appreciated. It means that by the expenditure of a certain amount of power, depending upon the conditions of the cooling water, the friction of the machine, etc., a plant giving one "ton of refrigeration" (per day) will extract 1950 thermal units per minute from any substance that it cools, such as the air of a cold-store, the brine, and so on. It must be remembered that all of the successive coolings mentioned above, where brine cooling and air cooling are employed, must be allowed for in the calculation.

Another caution must be given, where the power required is for ice making, the plant which is rated as giving one "ton of refrigeration" will only produce ½ ton of ice per day. It may produce a little more than ½ ton, but this is the rule that is adopted by refrigeration engineers. The reason is as follows: The ton of refrigeration is the amount of heat that a ton of ice at exactly 32 deg. Fahr. will absorb in melting to water also at 32 deg. Fahr. When ice is made from water, it must first be cooled from its normal temperature, which may be as much as 80 deg. Fahr., or more in summer, to the freezing point 32 deg. Fahr., and after it is frozen, its temperature must be lowered, usually to the neighborhood of 15 deg. Fahr., in order to make the ice stable. Sloppy ice is of no use to anyone, and ice which is only at or just below freezing point, would be sloppy. The slightest heat, the slightest friction, would cause it to become liquid.

The amount of power employed in the United Kingdom for cold storage is not great. The seaports Liverpool and Hull take most, Liverpool in particular having several plants, up to as much as 80 hp. Hull has plants taking up to 70 kw, and Cork has a total of 185 hp. Bristol has only 30 hp. In nearly all cases there is a difference between the demand for winter and summer, ranging from 2.5 to 1, down to 1.5 to 1. At Liverpool the difference appears to be smallest, mainly because of the very large trade in frozen meat that is carried on there.

In no case does the demand by the cold-storage companies affect the load at the central station, except at Wolverhampton. In Wolverhampton, where the corporation owns the cold-store, the electric light and the tramway service, an arrangement is made by which the cold-store is shut off during time of peak load.

Methods of Drive for Alternators.

By J. E. Latta.

In the design of steam-driven, alternating-current electric plants of small output the selection of the prime movers is a part of the problem frequently not given the consideration the matter deserves. The following discussion will be confined to 60-cycle alternators. Three different types of reciprocating steam engines will be considered, namely, engines having some form of slide-valve; the engine with Corliss valves, but without the releasing mechanism and dashpots which constitute parts of the valve gear of the standard Corliss type; and, finally, the Corliss engine. These three types will be referred to, respectively, as "the slide-valve engine," "the high-speed Corliss engine," and "the Corliss engine."

If the rating of an alternator be less than 50 kw it is always designed to be belt driven. These small generators are usually either four-pole or six-pole machines, and hence the speed is either 1800 r.p.m. or 1200 r.p.m. Now, unless an automatic belt tightener be employed, the operation of belts is almost certain to be unsatisfactory when the diameter of the larger pulley is more than six times that of the smaller. A Corliss engine for one of these alternators would run at about 100 r.p.m., and therefore the ratio of the diameter of the driving wheel to that of the dynamo pulley would have to be at least 12 to 1. High-speed Corliss engines are not built in such small units. The use of an automatic belt tightener is to be avoided whenever possible, since this piece of apparatus is unsightly, noisy and inefficient. Obviously, then, the best thing that can be done in the case in hand is to belt the alternator to a slide-valve engine.

When the rating of the alternator is 150 kw and the frequency 60 cycles those designed for belt drive generally run at 600 r.p.m., while those arranged for mounting the rotating

member directly on the engine shaft (that is, for direct drive, as this method of drive is termed) have a speed of 225 r.p.m. A 225-hp engine is needed to drive a 150-kw alternator operating at about 100 per cent power factor. Corliss engines of this output can be operated successfully at 100 r.p.m.; 225 r.p.m. is the standard speed of the 225-hp high-speed Corliss engine; and any slide-valve engine of this rating may be run, of course, at 225 r.p.m. It follows, then, that three methods of drive are to be considered here: Belt drive from a Corliss engine, direct drive with a high-speed Corliss engine, and direct drive with a slide-valve engine. Belt drive might be employed, to be sure, with either of the last two prime movers; but the only thing to suggest it is the fact that the belted alternator would be lower in first cost than the other, and the loss of power in the belt would more than offset this advantage. The first cost of the Corliss engine, belt and belted alternator, would be but little less than that of a high-speed Corliss engine and alternator arranged for direct drive. The efficiency of the latter unit would exceed that of the former by the power lost in the belt, the term efficiency here being taken to mean the ratio of the power delivered at the generator terminals to that delivered to the cylinder of the engine. In units of this output there is a difference in efficiency of about 17 per cent in favor of the high-speed Corliss engine and directly driven alternator as compared with the slide-valve engine and directly driven alternator. Hence, unless the load-factor of the plant is very poor or fuel very cheap, it would generally be best to adopt in this case the second of the three methods of drive suggested.

What has just been said concerning the 150-kw generator applies also to machines of ratings up to 300 kw. At 300 kw the field of the steam turbine is entered. The writer is aware that there is a type of steam turbine built in smaller units than this (two different types, in fact), but the use of these turbines as prime movers for alternating-current generators has not become at all general and probably never will become so.

Coming now to alternators having full-load ratings of as much as 50 kw and not as much as 150 kw, it is to be noted that present engineering practice is to employ direct drive for these. However, in more than a few cases proper considerations of economy would demand that the alternator be belted to the engine; not to a Corliss engine, for the speed of this would differ too much from that of the generator; nor to a slide-valve engine, for, if one of these is to be used, the fact that within the rating limits mentioned standard speeds of engines and of 60-cycle alternators are the same, makes direct drive, with the resultant saving over belt drive in coal and floor space, easy and convenient; but to a high-speed Corliss engine. Consider, for instance, a 75-kw alternator of the frequency mentioned. If directly driven, the speed of this machine would be 277 r.p.m., which is altogether too high for a high-speed Corliss engine. Hence, if this latter machine is to be adopted as the prime mover, belt connection must be resorted to. With this belt drive either a six-pole or an eight-pole alternator would be used. The most satisfactory service would probably be obtained with the eight-pole machine, the speed of which would be 900 r.p.m. The best speed for the engine would be about 225 r.p.m.

Let it be assumed that the engine is to be of simple type and is to run non-condensing. Assume further that the boiler pressure is 90 lb., and that the alternator can be operated 10 hours a day on an average load of 50 kw. The engine rating needed for this alternator would be 115 hp, unless the power factor differed considerably from 100 per cent. A high-class slide-valve engine driving the generator in question under the conditions assumed would consume about 47 lb. of dry steam per kw-hour delivered to the switchboard; and any high-speed Corliss engine operated under the same conditions of load, boiler pressure and so on, would develop a kw-hour of energy, measured at the flywheel, on 38 lb. of dry steam. The alternator itself would have an efficiency at 50 kw output of about 90 per cent; and, therefore, the power required to run it would be 55.5 kw. If properly installed and not run unnecessarily tight, the belt for driving the alternator with a high-speed Corliss engine should have an efficiency of 95 per cent. This being true, the engine would be called upon to deliver to the belt an average output of 58.4 kw.

It appears, then, that in the case of the slide-valve engine the average steam consumption per hour would be 50 × 47, or 2350 lb., while with belt drive from the high-speed Corliss it would be 38 × 58.4, or 2220 lb. Thus the saving in steam would be 1300 lb. a day. Assuming that the engine gets 7 lb. of dry steam per pound of coal burned in the boiler, the daily saving in coal would be about 186 lb. If the plant be operated 365 days in the year, the annual saving in coal is thus seen to be approximately 34 tons. Under the conditions relative to water supply usually existing in the average plant, the saving in water would more than cover first cost and maintenance of belts. With coal at $4 a ton (the writer knows of plants that have to pay more than this for good coal), $136 per year would be saved in fuel. The belted unit would cost not over $400 more than the directly connected unit, and the maintenance cost of the two would not differ materially. In a little over three and one-half years, then, the decrease in fuel consumption resulting from the use of the high-speed Corliss engine with the belt drive thus made necessary would repay the $400 and the interest thereon at 6 per cent per annum. During the rest of the life of the engine, which life would be as long as that of a slide-valve engine, there would be a net saving of $136 a year.

It is to be noted, too, that the necessity of securing and maintaining exact alignment of all the bearings in a directly connected unit makes the erection of this unit a rather difficult job and causes the machine to require careful attention while in operation. It is decidedly easier to set up and operate a belted engine. The difficulty of getting three bearings into proper alignment and keeping them there is causing the side-crank engine to make very rapid gains in popularity over the center-crank types. All of the high-speed Corliss machines are built with side cranks, and very many of the steam-engine manufacturers are adopting the side-crank arrangement on slide-valve engines formerly built with center cranks.

The assumptions of the foregoing comparison of the two methods of drive are not foreign to practice. The data as to steam consumption come from trustworthy tests on three different types of high-speed Corliss engines and twice that number of well-known slide-valve engines. The figures concerning the cost of apparatus are made up from actual experience in buying machinery of the kind considered. Where there was any doubt in the writer's mind as to the justness of an assumption, the slide-valve engine and direct drive were given the benefit of it. There are numerous plants in the country where the sort of belt drive just spoken of would result in a greater saving than that figured out here. Where floor space is expensive, however, belt drive for generators may be impracticable. Moreover, this kind of drive should not be adopted if small rotary converters are to be run by the alternator, for the slightest unsteadiness in the belt is almost sure to cause troublesome hunting in the converters. However, belt drive is no obstacle in the way of the parallel operation of alternators; in fact, the belts frequently act as a sort of relief valve to take care of the idiosyncrasies of bad governors or poorly balanced engines.

Protection to Station Apparatus.

By MAX H. COLLBOHM.

THE protection of the station apparatus against high-frequency surges produced by lightning entering over the transmission wires is invariably effected by the use of lightning arresters and choke coils. The latter are placed close to and between the point where the lightning arresters tap off and the station apparatus. The station wiring consists in all cases of copper, with a tendency to employ copper tubing instead of solid wires or cables, as exemplified by prominent stations recently completed, or under construction.

The choke coils commonly used on high potential circuits

consist of about 20 turns of a solid copper wire supported upon proper insulators and having a coefficient of self-induction of about 1×10^{-5} henry. On transmission voltages above 60,000 volts usually two such coils are used in series. The counter e.m.f. of such a coil in case of a lightning stroke with a frequency of from 500,000 to 1,000,000 cycles is from about 30 to 60 volts per ampere of current passing through the coil, which, being in quadrature with the exciting current, reduces the transient voltage only by a very moderate amount with a corresponding low degree of protection to the station. An increase of self-induction by using a greater number of turns does not appear advisable on account of the difficulty to build such a coil with sufficient stiffness; it would, furthermore, require quite some additional valuable space in the power house and in the form generally built may become subject to flashing over on heavy surges of very high frequency. This phenomenon is very likely on an apparatus of such kind, as it is constantly under a high potential strain and the comparatively still air between the windings may therefore become highly ironized and break down on account of its decreased disruptive strength.

The writer desires to propose a method for station wiring which is free from the before-mentioned disadvantages and which is believed to serve well in such cases where protection is sought by adding inductance to the circuit. This method consists in the use of solid iron wires of high permeability which must not be galvanized or in any way coated with a conducting non-magnetic film. The protection offered by such an iron wire is due to the skin effect which under high-frequency currents will decrease the conductance enormously without offering the least chance for any flash-over. The feature which is particularly valuable in this system is the fact that the ohmic voltage drop in the iron wire, which on account of the skin effect is very great, is practically in time phase with the transient voltage and tends to reduce the latter in a larger measure than a copper choke coil would do with its negligible ohmic voltage drop, although the coil may eventually produce an impedance voltage considerably greater than the iron wire.

The iron wire installation must comprise the whole high-tension wiring; that is, it must extend from the transformer high-tension terminals to the place where the leads to the lightning arrester tap off from the line. In cases where the connection from the outgoing line to the transformer is very short, the choke coils of usual design, but preferably with coils of iron wire, must be used and the iron wire connections may be taken as an additional protection. In cases where electrolytic arresters are used in series with spark gaps outside the iron wires may be extended quite a distance outside the power house by connecting the leads from the arrester spark gaps to a point on the line as far away from the station as practicable (to the next tower, if possible). The leads to the spark gaps and arresters and from the latter to ground must, of course, be of high conductivity and contain a minimum of inductance; that is, they must be of copper, preferably in form of tubing or flat ribbon, and arranged so that the discharge path to ground is as short as possible and in as nearly a straight line as the conditions will allow.

When wiring up an intermediate (second) generating station through which runs the transmission line from another (first) generating station, care must be taken to install the iron wire and choke coils only in the branches connecting to the main line, but not in the main line itself. The reason for this is to allow a lightning stroke entering from the side of the first station to pass through the second station and discharge over the arrester on the line to the substation. This precaution is necessary in cases where on account of the short distance between the two generating stations the second station is not equipped with lightning arresters for the incoming line, but only for the outgoing line. It is, furthermore, of great importance to place all apparatus especially liable to damage under high-frequency surges, such as series transformers and series ammeters, as far back from the line as possible. All apparatus in the main line having series coils (series relays, series transformers, etc.) must be equipped with sensitive spark gaps or much better by a single small electrolytic cell, preferably placed directly in the high-tension bus compartments across the terminals of the apparatus to be protected, to allow the passage of lightning without puncturing the apparatus.

The method before described besides offering superior protection may prove quite economical on account of the saving in copper, and particularly when choke coils may be omitted, by saving in building space, which under circumstances may amount to several thousand dollars. The inductive effect on normal frequencies and the ohmic losses in the iron wires as against non-magnetic conductors can be considered negligible. The corrosion of the iron wires may be avoided by coating them with shellac or some rustproof paint.

It appears that the protection given to a transmission system can be considerably augmented by reversing the present methods—i. e., change the iron guard wires over the transmission line to copper or copper-clad steel, as recently discussed by the writer in these columns (*Electrical World*, May 20, 1909) and change the copper wires in the power house to solid iron wires of high magnetic quality.

Alcohol for Internal-Combustion Engines.

The United States Geological Survey has issued a bulletin entitled "Commercial Deductions from Comparisons of Gasoline and Alcohol Tests on Internal-Combustion Engines," by Mr. Robert M. Strong, giving the results of tests made under the direction of Mr. R. H. Fernald at the fuel-testing plants in St. Louis, Mo., and Norfolk, Va.

To determine the relative economy and efficiency of gasoline it was compared with denatured alcohol. When the series of tests was started, it was found that it took from one and one-half to two times as much alcohol as gasoline to produce a given power. With special alcohol engines, entirely suited to the use of alcohol, the latter fuel has been made to do as much work, gallon for gallon, as the gasoline. The bulletin states that by using alcohol in an alcohol engine with a high degree of compression (about 180 lb. per square inch above atmospheric pressure—much higher than can be used for gasoline on account of pre-ignition from the high temperatures produced by compression) the fuel consumption rate in gallons per horsepower per hour can be reduced to practically the same as the rate of consumption of gasoline for a gasoline engine of the same size and speed. The indications are that this possible 1-to-1 fuel consumption, ratio by volume, for gasoline and alcohol engines, will hold true for any size or speed if the cylinder dimensions and r.p.m. of the two engines are the same.

The tests showed that the low heating value of completely denatured alcohol will average 10,500 Fahr. thermal units per pound, or 71,900 pound-Fahr. units per gallon. The low heating value of 0.71 to 0.73 specific gravity gasoline will average 19,200 thermal units per pound, or 115,800 units per gallon. The low heating value of a pound of alcohol is thus approximately six-tenths of low-heating value of a pound of gasoline. It was found that a pound of gasoline requires approximately twice the weight of air for complete combustion as a pound of alcohol.

A gasoline engine having a compression pressure of 70 lb., but otherwise as well suited to the economical use of denatured alcohol as gasoline, will, when using alcohol, have an available horse-power about 10 per cent greater than when using gasoline. When the fuels for which they are designed are used to an equal advantage, the maximum available horsepower of an alcohol engine having a compression pressure of 180 lb. is about 30 per cent greater than that of a gasoline engine having a compression pressure of 70 lb., but of the same size in respect to cylinder diameter, stroke and speed.

Alcohol diluted with water in any proportion, from denatured alcohol, which contains about 10 per cent of water, to mixtures containing about as much water as denatured alcohol can be used in gasoline and alcohol engines if they are properly equipped and adjusted. When used in an engine having a con-

stant degree of compression, the amount of pure alcohol required for any given load increases, and the maximum available horse-power of the engine decreases, with a diminution in the percentage of pure alcohol in the diluted alcohol supplied. The rate of increase and decrease, respectively, is such, however, that the use of 80 per cent alcohol instead of 90 per cent, or denatured alcohol, has but little effect upon the performance of the engine; so that if 80 per cent alcohol can be had for 15 per cent less cost than 90 per cent alcohol and could be sold without tax when denatured, it would be more economical to use the 80 per cent alcohol.

The relative hazard involved in the storage and handling of gasoline and denatured alcohol is of particular importance in considering their use as fuels for marine and factory engines and engines to be placed in the basements of office buildings or in similar places where a general fire would be likely to result from the accidental burning of the fuel stored or carried for immediate supply, or where the forming of explosive or inflammable mixtures of the fuel vapors and air in the immediate vicinity would be hazardous.

In regard to general cleanliness, such as absence of smoke and disagreeable odors, alcohol has many advantages over gasoline or kerosene as a fuel. The exhaust from an alcohol engine is never clouded with a black or grayish smoke, as is the exhaust of a gasoline or kerosene engine, when the combustion of the fuel is incomplete, and it is seldom, if ever, clouded with a bluish smoke when a cylinder oil of too low a fire test is used or an excessive amount supplied, as is so often the case with a gasoline engine. The odors of denatured alcohol and the exhaust gases from an alcohol engine are also not likely to be as obnoxious as the odor of gasoline and its products of combustion.

Very few alcohol engines are being used in the United States at the present time, and but little has been done toward making them as adaptable as gasoline engines to the requirements of the various classes of service. Engines for stationary, marine and traction service, automobiles, motor trucks and motor railway cars designed especially to use denatured alcohol have, however, been tried with considerable success.

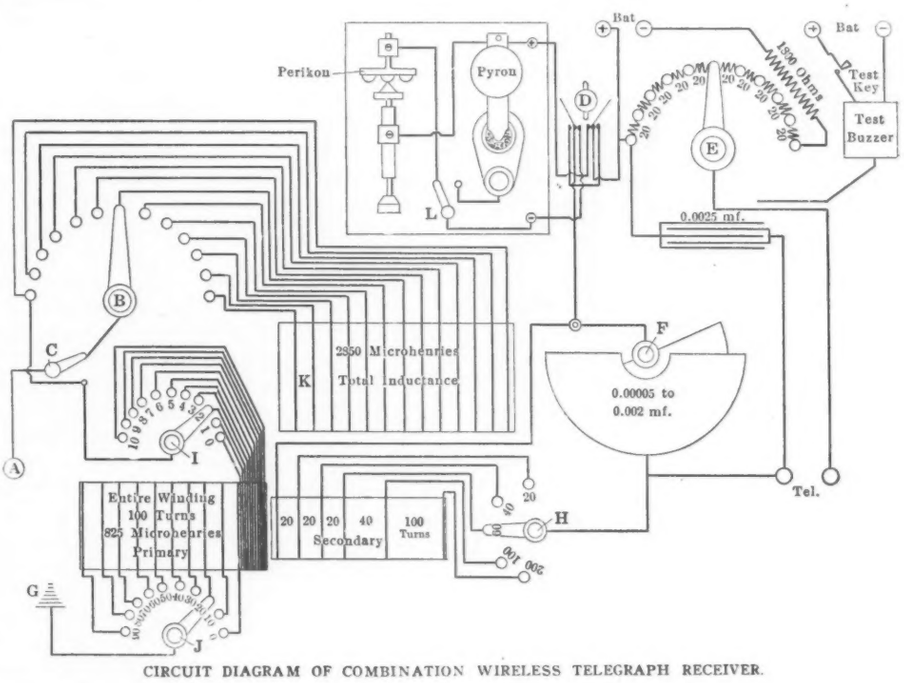
The price of denatured alcohol is greater than the price of gasoline, and the quantity of denatured alcohol consumed by an alcohol engine as ordinarily constructed and operated is in general relatively greater than the quantity of gasoline consumed by a gasoline engine of the same type. Considerable attention is being given to the development of processes for the manufacture of alcohol from cheap raw materials which are generally available, and it seems reasonable to expect that the price of denatured alcohol will eventually become as low or lower than the price of gasoline, especially if the price of gasoline advances. It also seems reasonable to expect a greater general improvement in alcohol engines than in gasoline engines.

When the restrictions placed upon the use of denatured alcohol are less than those placed on the use of gasoline or where safety and cleanliness are important requisites, the advantages to be gained by the use of alcohol engines in place of gasoline engines may be such as to overbalance a considerable increase in fuel expense, especially if the cost of a fuel is but a small portion of the total expense involved, as is often the case. Denatured alcohol will, however, probably not be used for power purposes to any great extent until its price and the price of gasoline become equal and the equality of gasoline and alcohol engines in respect to ability to service required and quantity of fuel consumed per brake horse-power, which has been demonstrated to be possible, becomes more generally realized.

A further general development in the design and construction of engines that use kerosene, or cheaper distillates, and the crude petroleums may be reasonably expected and may delay the extensive use of denatured alcohol for some time to come, but as yet comparatively few data pertaining to this phase of the general investigation are available.

Combination Wireless Telegraph Receiver.

A type of combination wireless telegraph receiver, which is very compact and efficient, is being installed on all the newer ships in the United States Navy and at a good many of the shore stations. Its compactness and absence of numerous connections spread over and under the operating table make it very desirable for use aboard ship. Stations and ships where this new receiver has been installed are receiving signals from a greater distance than previously, and some new records will no doubt soon be established. The U. S. S. *North Carolina*, while returning from the recent Taft celebration at New Orleans, and having on board this new type of receiver, was in communication with Chicago, Ill., while off Charleston, S. C., and it was also in communication with the Norfolk Navy Yard while at the mouth of the Mississippi River, the Navy Yard station also being equipped with this new type.



CIRCUIT DIAGRAM OF COMBINATION WIRELESS TELEGRAPH RECEIVER.

A diagram of the connections of the receiver is shown herewith. The receiver proper comprises a telescopic transformer tuner, extra variable inductance for receiving long wave-lengths, a variable-capacity air-condenser for tuning the secondary circuit and the detectors; two detectors are used, namely, a perikon and a pyron or perikon and silicon and associated with them is a potentiometer, a testing buzzer, a condenser of fixed capacity, a battery and telephones.

There are two main circuits, the primary or antenna circuit, and the secondary or detector circuit. The primary coil of the transformer is wound on a hard-rubber hollow tube and is stationary. The secondary coil is also wound on a hard-rubber tube, but is movable in respect to the primary; the coupling between the primary and secondary in this manner can be varied and the tuning thereby made sharp or broad, depending upon the mutual induction between the two circuits.

The primary winding has 100 turns of No. 22 B. & S. wire, controlled by the two dial switches *I* and *J*, these switches adjusting the number of turns in circuit by single turns, and by tens of turns, respectively. Thus, to insert a primary winding of 42 turns, *J* would be set on contact stud No. 40 and *I* on contact stud No. 2. With an antenna of average capacity the primary turns alone will be sufficient for any wave-length up to 1500 m, but in case a longer wave is being sought for, an extra inductance is inserted by means of the key switch *C*, and wave-lengths up to 4000 m can then be received. This inductance, which has the action of a loading coil, is shown at *K*, there being a total inductance of 2850 microhenrys divided into 12 sections and controlled by the switch *B*.

The secondary of the transformer tuner is subdivided into four sections controlled by the dial switch *H*. The studs are marked 20, 40, 60, 100 and 200 and read directly in number of secondary turns. For wave-lengths in the neighborhood of 330 m, 20 turns are sufficient to give the maximum strength of signal; the number of turns increases in direct proportion as the wave-length increases. The secondary is shunted by a variable-capacity air-condenser *F*, with which the greater part of the secondary tuning is done. When tuning, the secondary circuit is first made fairly closely coupled as when the secondary winding is partly inside the primary, and then slowly drawn out, the condenser being readjusted from time to time until the sharpest tuning is obtained. All interference will then be cut out except that from a strong forced wave or waves identical in length with the one being received.

For long-distance work on signals of weak intensity the perikon detector is used, while for short-distance work or signals of strong intensity the pyron or silicon is used, on account of the sensitiveness of the perikon being destroyed by strong signals. The switch *L* is used to throw either one in or out. While transmitting, the detector is put on open-circuit by means of the key-switch *D*. Use is made of one dry cell around the potentiometer so connected that the single or chalcopyrites crystal of the perikon and the steel point of the pyron are positive. The telephones used with this receiver are of a late type in which the electromagnets are adjustable from the back of each receiver, and the distance between magnets and diaphragm may thus be varied. The antenna is connected to the primary winding at *A* and the ground lead is taken off at *G*.

Electric Signaling in Automatic Fire-Alarm Systems.

The sixth and last of the series of lectures based on the National Electrical Code, by Mr. B. E. Blanchard, chief electrical inspector of the Chicago Board of Underwriters, before the Fire Insurance Club, of Chicago, was delivered on Nov. 23. The subject, as announced, was "High-Potential Systems," but more attention was devoted to moving-picture machines, thermostats, inspectors' supervision of automatic sprinklers, valve alarms and journal alarms. There was a good attendance, and, following the pleasant practice of the club, the main features of the evening were interspersed by entertainment—in this case the singing of the Schubert Quartet.

In insurance parlance, high-potential systems mean wires carrying between 550 volts and 3000 volts. Electrical circuits carrying higher voltages are styled extra high-potential systems by the underwriters and their inspectors. Inside buildings the maximum potential permitted by the Code is 3500 volts, and special regulations apply to pressures as high as this. One stipulation is that the covering on the wires must not be relied upon for insulation, which must be provided by approved insulators. The covering on the wires is intended to prevent danger from accidental contacts. Transformers must be placed in a separate fireproof room. In the case of extra high-potential wires, as defined by the underwriters, they must not be brought into buildings at all, except in the case of power stations and substations.

The speaker devoted some attention to the hazards of moving-picture machines and described the construction of the fireproof booth required for the machine. The lamp and rheostat must be installed under the same rules as apply in theaters. During five years Mr. Blanchard has only known of two fires in moving-picture theaters which extended beyond the booth in which the machine was operated. This shows the wisdom of making the booth of fireproof construction. It is essential that the lamp rheostat should be of ample size, and it also must be placed in the fireproof booth. It seems that in some cases these rheostats have been placed in ticket offices of moving-picture shows in order to utilize the waste heat to keep the ticket office warm; but this practice is condemned by the underwriters.

Taking up the thermostat as used in automatic fire alarms and in journal alarms, the speaker described the construction of the device and its method of operation. The essential feature is enclosing a compressed spring in solder, which melts at a predetermined temperature and releases the spring, which closes an electrical circuit and so gives an alarm. Thermostats, when used as fire alarms, are often installed on ceilings, and each one can protect in this way a ceiling area of from 100 sq. ft. to 144 sq. ft. Mr. Blanchard described how the thermostat used in an automatic fire-alarm system may be tested, and he gave a number of diagrams illustrating the parts of the apparatus. Thermostats are useful because they are automatic in operation and give an alarm of fire in its earliest stages, when the alarm should be particularly valuable.

Automatic journal alarms are installed in 17 grain elevators in Chicago. These signaling devices give warning of when bearings are running hot and also indicate the location of the machine with a hot bearing. One electrical circuit may protect 24 journal bearings by means of thermostats adapted for the purpose. If the bearing reaches a heat of 165 deg. Fahr. the solder is melted and a spring released closing the circuit and ringing a bell in the superintendent's office, at the same time dropping an annunciator shutter. It is necessary, of course, to keep the thermostats in the bearings, and the inspector should see that this is always done. The method of testing the system was described in some detail. The thermostats themselves can be tested by placing a piece of jumper wire between the contact points, when, of course, the device should operate in the manner intended. The journal alarm systems in Chicago grain elevators are tested twice a month.

Some attention was devoted to gate-valve signals, tank-level alarms and the electrical inspectors' supervision of automatic sprinkler systems. The methods of testing these appliances were briefly explained. In closing, Mr. Blanchard called his hearers' attention to the fact that while electricity has been accused of causing some fires, it must not be forgotten that it furnishes a valuable defense against fire. When one thinks of the alarms of fire transmitted by the telephone alone, the immense importance of electrical signaling as a protective measure is realized. In many towns the telephone furnishes the only fire alarm. Incidentally, it was mentioned that in six colleges—Armour Institute, University of Pennsylvania, University of Michigan, Case School of Applied Sciences, University of Wisconsin and Leland Stanford, Jr., University—there are 1107 students in the electrical engineering courses. Of these, 178 will graduate next year. These young men, and others taking corresponding courses in other colleges, by their work in the coming years will have a great influence on future electrical development and with their scientific education they may be relied upon to advance the standard of electrical construction.

After the lecture a number of pictures were thrown on a screen illustrating famous conflagrations. After that the reflectoscope was brought into use. This is a stereoscope with the lens in front of a powerful arc lamp, so arranged that the picture itself becomes the reflector and is thrown upon the screen. By means of this instrument any photograph, drawing or half-tone illustration in a periodical can be projected upon a screen before an audience. In this way pictures of wiring conditions in various cities were shown, and also portraits of many electrical celebrities. Mr. Blanchard wound up by dis-

playing a picture of Mr. Thomas Cooper, the president of the club, which was received with great applause. He then retired and Mr. Cooper took his place at the instrument and displayed the pictures of a number of popular members of the club, including that of Mr. Blanchard, whom he styled "the electrical wizard of LaSalle Street."

A Year's Performance of a Double-Zone Gas Producer.

In October, 1908, the Western Chemical Manufacturing Company, at Denver, Col., installed two 175-hp Westinghouse double-zone gas producers for the supply of gas to gas engines in its electric generating plant and for other purposes in connection with its furnaces. Later a third similar producer was added. These producers have been operating on Colorado lignite coal. As they were the first of the new Westinghouse double-zone, or double-flow, producers suited for the use of soft coal to be placed in commercial use outside of the Westinghouse factory, considerable interest attaches to their performance in the Denver plant mentioned.

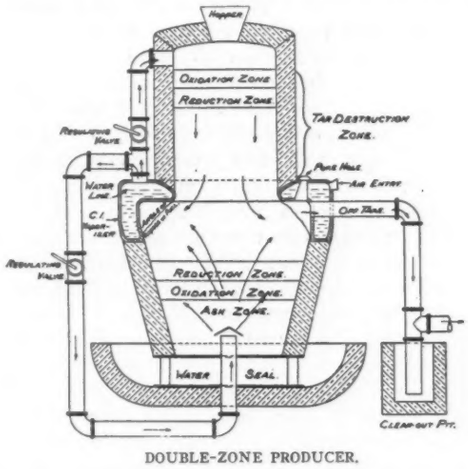
Mr. L. B. Skinner, chemist and metallurgist for the Western Chemical Company, gave a rather complete account of the experience of the company with gas producers for gas-engine purposes in a recent paper read before the Colorado Section of the Western Association of Technical Chemists and Metallurgists. The illustration accompanying this article and some of the facts are taken from that paper, other facts having been obtained by a visit to the plant. The company previously to installing these producers had tried another type of soft-coal producer for some time, and had found it unsatisfactory with Colorado lignite coal. After a trial with Colorado lignite in the double-zone producers at the maker's factory, the results were so satisfactory that two of these producers were ordered.

The accompanying engraving shows diagrammatically principles of construction and operation of the total zone producer. It is like an up-draft producer placed above a down-draft producer. The principal difficulty with bituminous and lignite coal as used in producers has always been the presence of tar in the producer gas. This tar coats up the engine valves, igniters and pistons so as to make continuous operation impossible. If, however, the volatile gases which contain this tar are heated to a sufficiently high temperature when they are in the producer, the tar becomes fixed and will not condense out of the gas after it leaves the producer. The object of the double-zone producer is so to heat the volatile gases given off from the green coal that they become fixed and no tar can be obtained from them. In the illustration it is seen that air is admitted both at the top of the producer above the coal bed and at the bottom of the producer under a cone in the ash bed. Coal is charged through the hopper at the top, as in any other producer, this hopper being provided with an air lock, so that air cannot rush in at the time of stoking.

The producer is of the suction type, and an exhauster is used to maintain suction on the producer continuously. The course of the air and gas through the producer is shown by the arrows. The air is taken from over the surface of the water in the cast-iron vaporizer which surrounds the middle of the producer. The upper part of the producer magazine is smaller than the lower part. The natural angle of repose of the coal is such that there is an open space under the cast-iron vaporizer from which the gas is drawn off. In this way there is no restriction to the passage of the gas except the fuel itself, and the offtake cannot be clogged. The heat of the offtake is reduced by the vapor pan. There is no trouble with the burning out of grates as in some down-draft producers, because the hot gases do not pass through any grate. The steam given off from the water in the vaporizer moistens the air going into the producer in proportion to the rate at which gas is being drawn off, because the more gas being used, the more heat is given to the water in the vaporizer. The outgoing gas is pulled through the usual cooling scrubbers, in which water is kept running over rocks. Suction is produced by a Connersville blower operated by a 15-hp motor. This furnishes suction for the three 175-hp producers. Mr. Skinner states, however, that 5 hp would be sufficient for producing this suction with a suitable type of exhausting apparatus. The amount of gas passing through the producers is regulated by the demand of the engines, as the exhauster is not of the positive type.

The engines are in continuous service 24 hours per day. Ashes are removed and fires worked during running. One man per shift takes care of the three producers. Test runs show a consumption of 1.6 lb. per brake hp-hour of Colorado lignite of 9250 pound-Fahr. units. The gas produced runs about 120 units per cubic foot. Under ordinary running conditions the gas is practically tarless, as is shown by the condition of the engine valves. Chemical tests show that the gas contains only from 0.01 gr. to 0.02 gr. per cubic foot of lampblack and tar. The best evidence of the freedom from tar is the fact that the engines are able to operate continuously without trouble. However, when the producers are run very lightly loaded, as when three producers are used to supply one engine, on a very light load, it is found that the exhauster extracts some tar from the gas. This, of course, is due to the low temperature at which the producers must operate under such conditions, and is obviated by cutting out one or more producers. The temperature of the producer must be sufficient to fix the volatile hydro-carbon gas and prevent the condensation of tar.

When the producers were first started no steam was introduced into the upper fire, as it was thought that the lignite itself attained sufficient moisture. This style of working gave gas



DOUBLE-ZONE PRODUCER.

free from tar in the preliminary test runs at Pittsburgh, but in the rarefied dry air of Denver an oily substance in the gas was obtained. Mr. Skinner found that upon throwing fresh coal on the fire it ignited almost immediately from the volatile products given off, and that the fire left the burning layer below and came up to this fresh material. This produced so much volatile matter that some passed through the hot zone without becoming a fixed gas.

The electric generating plant supplied by these producers consists of one 120-kw, 60-cycle, 220-volt alternator direct-connected to a 16-in. x 18-in. three-cylinder vertical Westinghouse single-acting gas engine, and one 80-kw alternator direct-connected to a 15-in. x 14-in. engine of the same type. These engines are 140 hp and 190 hp, respectively, at sea level, and 120 hp and 160 hp at the altitude of Denver, there being, it is stated, a loss of from 16 per cent to 20 per cent in capacity due to the rarefication of the air at this altitude. The cost of the plant was about $200 per kw, and it is operated on a load factor of about 37 per cent. The engine load factor (that is, the ratio of the capacity of the engines actually in service to the load) is 70 per cent.

After a year of operation, the experience in this plant seems to demonstrate that the double-zone producer worked at the proper load offers a satisfactory solution of the difficulties of

using soft coal for making producer gas for engines. Some mechanical defects have developed in the producers as first installed, which will necessitate some changes, but these are apparently not due to any fundamental difficulties with the apparatus and its principles, but rather with the details of design. The principal defect has been the cracking of the cast-iron vapor pans due to unequal strains. A successful soft-coal gas producer means much to small central stations, and the success obtained so far with this plant is very gratifying.

Central-Station Electrical Motor Service.

By Walter Stuart Kelley.

THE chief advantage possessed by electrical means over others for the efficient distribution of energy is that it allows of any degree of subdivision to eliminate friction and in subdivision can be so advantageously applied as to bring the all-day efficiency very nearly up to full-load efficiency—that is, obtain a high running load factor continuously.

The term "load factor" applies to the average condition for a definite length of time, while "running load factor" applies to a momentary condition and is used more generally for subdivisions of load than for a single prime mover. A plant may have a low load factor, while at the same time, by means of good engineering, maintain a high running load factor; in other words, while the average load is but a small proportion of the maximum load, each motor when running may operate at nearly full-load.

There are two other much used, but much abused, terms that require some consideration; these are "horse-power" and "efficiency." Referred to a steam engine, horse-power, unless otherwise defined, is understood to mean "indicated horse-power"—that is, the horse-power value of the steam as expended in the cylinder. Referred to a motor, horse-power, unless otherwise defined, is understood to mean "brake horse-power"—that is, the mechanical power delivered at the rim of the pulley. The "electrical horse-power" is the input in electrical units at the brushes, of which the brake horse-power may be anywhere from 50 per cent to 90 per cent.

Efficiency is one of the most common technical terms, but is often used without proper discrimination. In the case of a single prime mover, efficiency cannot remain uniform with greatly varying loads, but the term is ordinarily applied in such a manner as to ignore this fact, as will be apparent in what follows.

A given mechanical distribution of energy has, it may be assumed, a full-load efficiency of 60 per cent; in other words, with all the connected machinery in operation 60 per cent of the indicated horse-power is actually applied to the product and 40 per cent is used in getting the 60 per cent to the point where it is turned into the product-goods. It is commonly asserted in such a situation that the plant has a mechanical efficiency of 60 per cent; this statement can be correct, however, only when all of the machinery is being operated. As a matter of fact, scarcely any manufacturing plant operates continuously at full-load—that is, at 100 per cent load factor; indeed, full-load is the exception rather than the rule.

In any machine shop or wood-working shop there will be a number of machines that only require to be operated occasionally, even when the shop is turning out full product; when turning out half its normal output, only from 25 per cent to 35 per cent of the machines will be continuously in operation, but in the case of a single prime mover the friction load is usually constant regardless of the output.

As an illustration assume, to be liberal, that with one-half normal output one-third of the net or effective power is being applied to the machines that are in operation and continuously productive; therefore, one-third of 60—that is, 20 hp, or 20 per cent of the indicated horse-power or full-load power—is now used productively, but 40 per cent of the full-load power is still absorbed in friction.

The mechanical efficiency will now be $20 \div (40 + 20) = 33.3$ per cent. At one-fourth of full-load output we would have $10 \div (40 + 10) = 20$ per cent efficiency.

In any reference to this plant the efficiency would be stated off hand as 60 per cent, whereas it may actually be anything from that value down.

With electric motors for distributing power the rapid loss of efficiency with reduction of output, incidental to plants having a single prime mover, steam engine, gasoline engine or single large motor of any character, may be avoided; with a proper subdivision of the load, the partial-load efficiency can be maintained well up toward the full-load value.

The most accurate method of determining the actual efficiency of any given plant is to evaluate the friction in hp-hours along the lines worked out in the following tables. The first is for a mechanical transmission with a single prime mover, the second shows results with the same plant of machinery equipped with electric motors.

The assumptions upon which results are developed are as follows: Mechanical efficiency at full-load in each case, 50 per cent; number of sections, 10—a section may represent a single machine or several; full load, 100 brake horse-power; all transmission machinery to run 10 hours.

In the tables the column headed "excess" represents the added energy that might have been used productively with no increase in the friction load; the column headed "net" represents the energy used productively.

TABLE I.—ACTUAL EFFICIENCY WITH MECHANICAL TRANSMISSION.

Section.	Full-load power.	Hours of work.	Average power used.	Horse-power hours. Friction.	Excess.	Net.
A.....	5	2	4 hp	25	20	3
B.....	5	4	5 "	25	15	10
C.....	5	10	3 "	25	..	5
D.....	5	6	4 "	25	10	9
E.....	10	3	6 "	50	35	3
F.....	10	10	10 "	50	..	50
G.....	10	7	7 "	50	15	14
H.....	15	4	9 "	75	45	6
I.....	15	6	10 "	75	30	15
J.....	20	10	15 "	100	..	50
	100			500	170	165

Table I shows that the actual or running efficiency is less than one-half the full-load efficiency.

A point to be carefully noted in this connection is that the mechanical friction of a plant is almost invariably observed at no-load; in other words, the friction load is taken with nothing but the transmission system running, all belts being on loose pulleys. With all machinery running, the bearings subjected to the heavy strains of belt pull, and, in many cases, the shafts sprung out of line from this cause, the friction is sure to be more than that indicated by the no-load reading. Table I is, therefore, relatively favorable to the mechanical transmission.

TABLE II.—ACTUAL EFFICIENCY WITH ELECTRICAL DISTRIBUTION.

Section.	Hp of motor.	Hours of work.	Average power used.	Horse-power hours. Friction.	Excess.	Net.
A.....	5	2	4 hp	5	..	3
B.....	5	4	5 "	10	..	10
C.....	5	10	3 "	25	..	5
D.....	5	6	4 "	9	..	9
E.....	10	3	6 "	15	..	3
F.....	10	10	10 "	50	..	50
G.....	10	7	7 "	35	..	14
H.....	15	4	9 "	30	..	6
I.....	15	6	10 "	45	..	15
J.....	20	10	15 "	100	..	50
	100			324		165

By comparing Tables I and II it will be seen that for each 10 hours with mechanical drive the friction load totaled 500 hp-hours, while for each 10 hours with electric drive the friction load totaled 324 hp-hours. Hence the saving in friction load with electric drive was 176 hp-hours, or a saving of 35.2 per cent.

An inspection of the "average power" column shows that the running load factor is 75.1 per cent, whereas in a carefully designed plant the running load factor should be 80 per cent or better, barring exceptional conditions, or where practically uniform load conditions prevail. Even intermittent loads may be included with this statement, if the variation is between reasonably fixed limits, as in the case of a pump automatically feeding into a pressure tank, a deep-well pump or even a

planer (metal) by assuming normal full-load of the motor to represent 1700 per cent load factor, the variations extending both above and below.

In the case of the pump, suppose the pressure to vary between 100 lb. and 130 lb.; a motor could be selected of such power and characteristics that a considerable part of the load above 100 lb. pressure would be overload.

In the case of a planer, assuming that the installation is made so that the current rush on reversal is reduced to the lowest limits, the power for the high-speed return can be assumed as the full-load of the motor, then the over-load at moments of reversal will measurably balance the under-load when making a cut. In both these cases, therefore, practically full-load conditions—100 per cent load factor—can be maintained.

In any locality covered by central-station service little effort is needed to connect almost any small manufacturing business just starting.

This situation presents two classes of customers, the small motor user and the industrial building; the central-station argument with the former is along the following lines:

The continuous availability of the service; motors can be used at any time during the 24 hours, the meter taking care of both the time and amount of energy. The area covered generally allows of locating in a section where the rent is less than in the manufacturing district, or a man can build a shop near where he lives without taking upon himself the care and long hours incident to the use of boiler and engine. In either case he avoids the annual shutdown of the industrial building for repairs and overhauling; such shutdowns, lasting for a week or two, are a considerable hardship when customers are pressing for goods ordered.

A noteworthy feature of central-station service is that the cost of energy is measurably in proportion to the business done, whereas with an engine the cost can scarcely be brought as low as one-half of full-load cost. Other well-known stock arguments need not be marshaled here.

Some of the advantages of central-station service to industrial buildings are outlined herewith:

Tenants usually prefer electric motors, and the building thus served is more likely to keep its space occupied. Trouble is avoided whenever a tenant wishes to run overtime, the proprietor of the building has no bother, and the tenant secures the accommodation without unusual expense for service. The occasion for an annual shutdown is removed and the consequent annoyance and loss to the business of various tenants are avoided.

Fire risk is lessened by the avoidance of large belts passing from floor to floor. For the same reason more floor area is available, additional rental space usually being secured by removing engine, jack shafts and large pulleys.

By wholesaling energy to the proprietor on the basis of the aggregate demand registered, the latter is still able to furnish energy to tenants at a profit, and each gets his energy at the same price the central station would have charged the tenants individually.

These features all apply in the case of an old building, but with a new building the advantage is even greater, because usually a much better disposition can be made of the available rental space, together with a considerable reduction in the investment otherwise per square foot of area provided.

Having presented the argument to a prospective large energy customer with more or less elaboration, and the presentation of much evidence as to the greatly advantageous features of electric service, he should be convinced; doubtless he is, for he remarks, "Why, then, should I not put in my own electric plant and be independent of anybody else rather than take energy from the central station?"

This statement brings one to the crux of the whole situation, namely: central station versus isolated plant (a very hardy perennial) which involves a discussion of energy costs at engine pulley and the average efficiency of electrical generation, transmission and distribution.

It will be well to emphasize at this point the fact, which should be constantly kept in mind, that while good engineering will enable a high running load factor to be maintained on individual motors of an installation, this can rarely be done in the case of an isolated electric motor plant considered as a unit; that is, maintain a high running load factor on engine and generator; and the central station wins in the comparison because of this fact.

It is entirely possible, having suitable data at hand, to plot a curve of kw-hour, or annual costs, of an isolated power plant and superpose a curve of central-station costs for the same plant; if the curves cross, all points to one side will represent lower central-station costs and all points on the other side will represent lower isolated plant costs on the same basis.

A great deal has been printed in trade publications as to the cost of energy, both in large and small plants; these show wide variations in plants of the same size even, simply because conditions differ, so after all that has been published it is still necessary to evaluate for a definite set of conditions.

An elaborate presentation of the operating costs of steam-power plants was given in the *Electrical Engineer*, under date of June 26, 1895, entitled "The Cost of Steam Powers in Buffalo."

The first four columns in Table III give in abbreviated form the results for the smaller powers; the last column, for 10 hours, has been added to indicate proportionally the cost where the time reported was for more than 24 hours, although costs would not necessarily be proportional.

TABLE III.—POWER COSTS IN BUFFALO.

No.	Hp.	Hours.	Cost per hp-year.	10 hours (proportional.)
1	40-50	24	$145.58	$66.48
4	30-40	24	233.95	103.98
6	50-60	24	131.12	58.27
7	20-30	24	151.24	67.35
9	40-50	15½	76.45	60.00
10	20-30	9	108.27	108.27
11	10-20	9	173.33	173.33

The writer has had the opportunity of culling the actual items of expense from the books of a number of concerns operating steam-power plants rated at less than 100 hp, where normal load conditions prevailed. None of these kept any power account, consequently only such items of cost would be found as represented a cash outlay; missing items, such as interest, depreciation, insurance, floor area, etc., have been supplied. A composite of five of these, operating under fairly uniform conditions, is given in Table IV.

TABLE IV.—POWER COSTS, MEAN OF FIVE PLANTS.

Items.	Cost per annum.	Per cent.
Coal at $4 per ton	$1,495.20	43.1
Engineer (only labor)	922.60	26.6
Water (from city mains)	146.40	4.2
Ashes, removal of	52.60	1.5
Supplies, oil waste, etc	51.20	1.4
Depreciation, 7.5 per cent	213.00	6.2
Repairs	160.40	4.6
Interest, 5 per cent	142.00	4.1
Insurance	32.40	0.9
Taxes	39.00	1.2
Rental	211.80	6.1
	$3,466.60	100

Average hp, 49.28; cost per hp-year, $70.34.

This schedule of costs is for "power" alone; it does not include heating of any sort; if steam heat for building were to be included there would be an increased use of coal. The coal for heating would represent from 15 per cent to 20 per cent of the total coal used, bringing the proportionate cost of coal to over 50 per cent of the total steam-plant cost. The only one of the items that is unduly high is "repairs," because the plants were rather old.

TABLE V.—DATA OF THE INDIVIDUAL PLANTS.

	1	2	3	4	5
Total annual cost	$2,761	$3,260	$3,265	$3,549	$4,498
Average hp	33.46	46.26	47.00	53.50	66.21
Cost per hp	$82.51	$70.47	$69.47	$66.33	$67.93

Each of these steam plants is in a building having from three to five floors where "power" is rented to tenants operating mostly light machinery. The last, which is the largest of the five, has 62,786 sq. ft. of rental area, occupied by 20 tenants with from 900 sq. ft. to 7000 sq. ft. each. The steam plants could hardly be considered up to date, most of the engines were rather old and the boilers were return tubular with steam pressures of from 80 lb. to 100 lb.

Each engineer did his own firing, oiling and wiping, for

which there was ample time. Except in the case of the fifth, the steam plants were ample for the duty required.

Taken altogether, the conditions were such as to secure minimum fixed charges, and on the average a reasonably low cost of "power," all things considered.

The following comparison of various quantities and values incident to industrial buildings, both steam and electric, will be found of interest; similar results should be found in other buildings of the same area where light manufacturing is carried on.

TABLE VI.—COMPARATIVE RESULTS—INDUSTRIAL BUILDINGS.

	A.	B.	C.	D.	E.	F.	G.
Rental area, sq. ft.....	213,280	18,892	27,800	50,000	19,940	27,860	62,786
Rented with "power," sq. ft.	166,182	15,182	16,756	46,500	19,940	27,860	60,000
Electrical hp, per 1000 sq. ft.....	1.18	1.06	....	....	....	....	....
Indicated hp, per 1000 sq. ft.....	....	....	2.20	.99	2.30	1.92	1.10
Cost per electrical hp, year	$70.32	$90.12	....	....	....	....	....
Cost per indicated hp, year	....	....	$82.51	$70.47	$69.47	$66.33	$67.93
"Power" cost, per year, per 1000 sq. ft., cts.	8.982*	10.215*	16.47†	7.01	16.37‡	12.73	7.49
Average cost of "power" per sq. ft., electric, cents.....							9.598
Average cost of "power" per sq. ft., steam, cents.....							12.014
Excess cost of steam over electric, per cent.....							25.1

*Includes 10 per cent depreciation charge on cost of motors.
†High cost due to small area rented.
‡High cost due to inefficient engine.

It should be borne in mind that the comparison is between individual steam-power manufacturing plants and similar manufacturing plants operating with electric motors on central-station service, at a charge ranging from a little over 3 cents to nearly 5 cents per kw-hour.

These comparative results are interesting but not conclusive, as there are not sufficient cases to establish a rule, although the cases given are fairly representative.

Building (A) is a large establishment equipped entirely with electric motors, with an independent steam-heating plant; building (B) is also equipped entirely with motors, but buys its steam for heating; the cost of "power" is higher as a smaller discount was obtained; all the others are isolated steam plants. The high cost in buildings (C) and (E) partly balances the high cost in building (B). A careful estimate of building (G) equipped with electric motors, worked out in detail for each of the 20 tenants using "power," showed a cost on central-station electric service within the cost of operating as a steam plant.

The collateral advantages of electric drive, at the same cost for "power," make a building of this sort a much more attractive proposition as a revenue producer. An important argument for electric motors in the case of such a building is the ability and the ease of metering the energy, as it eliminates an element of considerable uncertainty in rentals, which occurs in the retailing of "power" from a steam plant. There is no easy and certain way of measuring the power distributed by shafting and belts from an engine to various tenants. By means of an indicator run instantaneously measurement can be made of the power taken by any one tenant, but this measurement can be made only with difficulty, and the operative conditions at the time the test is made may be exceptional and recur but rarely if at all; the watt-hour meter, on the other hand, makes a complete record of the energy used regardless of the time or the amount.

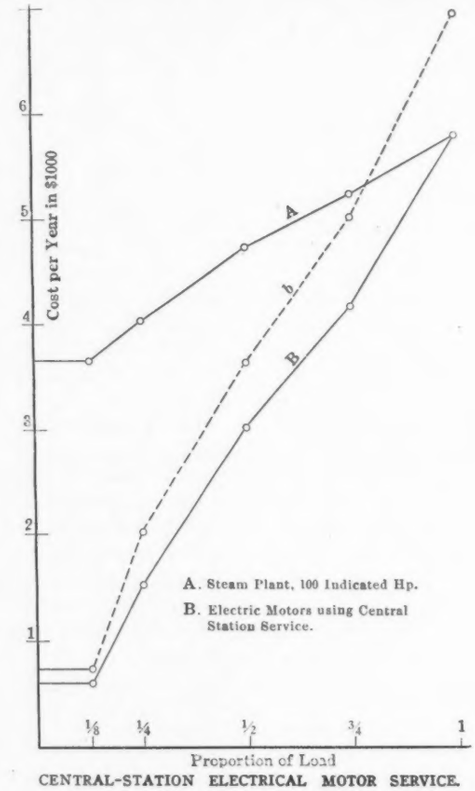
The "power" tenant pays for a certain estimated "power" by the year as part of his rent bill, regardless of whether he uses much or little; with dull business and his shop closed he pays for the "power" just the same, while with electric service from the central station, metered, he pays for just the energy used; if his shop is closed for a month he pays at most a small minimum charge.

The same principle works automatically as between the building proprietor or large manufacturer operating his own plant and the metered central-station service, as will be developed presently.

If a tenant in an industrial building with mechanical transmission is crowded with work and wishes to run over-time, the difficulties are well-nigh insuperable and if "power" is obtained it is at undue expense. The central-station customer has no trouble at all with energy for over-time, the meter takes care of the record, and the cost is no more per unit utilized.

With a knowledge of the conditions underlying the costs in the composite table given of steam "power" costs, it may be stated that a first-class plant rated at 100 hp using a simple, non-condensing engine, installed as part of a factory building, should produce "power" under normal conditions of operation, with coal at $4 per ton, for from $70 to $80 per annum for the ordinary day run, provided a fairly good load factor is maintained.

Suppose, now, that a party about to erect a manufacturing plant or an industrial building that will require 100 hp is willing to concede the commercial advantages of electric distribution, but thinks he will install an isolated plant; he doesn't want to be dependent on any outside source of energy; he wants his plant to be complete in itself. What is the central-station argument? The man must be shown that it is for his advantage to take energy from the central station, and shown in a very convincing way, or he will proceed to carry out his plans for



CENTRAL-STATION ELECTRICAL MOTOR SERVICE.

a fully equipped electrical distribution system. It is just here that the central station is likely to fall down, and after a weak argument gets the business, if at all, by a more or less drastic cut in rates; being driven from a strong position simply through inability to present the strong points of the situation; it is just here that the man who knows is valuable.

Here is the place to present, as forming the essential basis of central-station industrial service, certain specifications that are fundamental and which must be religiously carried out if the business is to be handled with success. First, prime movers ample in rating and equipped with the best apparatus obtainable for speed regulation. Second, ample active generator equipment with suitable reserves to throw into service in case of accident. In case the service is from hydroelectric transmission, character and reliability of service must be assured. Third, a distribution system having abundance of copper properly distributed in mains and feeders, with other essentials that will assure proper potential at the motor terminals.

A central station that does not maintain these three conditions effectively suffers a most serious handicap in getting profitable business. The character of the service, in the line of

reliability and uniform speed conditions for motors, is sometimes of far greater consequence than its cost.

There are two other conditions more strictly in the line of business policy that if observed will contribute not a little in securing business. Some will object to them, but experience has proved their efficacy; a secondary result of their strict observance is the maintenance of a high standard, physically and ethically. They are, first, a schedule of rates, sufficiently elastic to cover a suitable range of operating conditions, which is invariably maintained. Special rates are a snare and delusion. Second, all service contracts to be subject to termination after 90 days' notice from the customer; that is, no long fixed-term contracts, on the principle that it is not a proper policy for a public-service corporation to hold a customer against his will. No contract will yield a profit equivalent to the adverse moral effect of a dissatisfied customer.

Planted squarely on the foundation now laid, there may now be presented an outline of the central-station argument for its service instead of the isolated-motor plant, along the following lines:

The manufacturer is enabled to save a considerable investment which might be used more profitably in business operations or in putting up a larger building; in case of borrowed capital this much liability is saved.

"Power" represents ordinarily from 2 per cent to 5 per cent of the total cost of manufacturing, but in thought, time, annoyance and vexation, care of the various details of an isolated plant represents 25 per cent of what is expended on the entire business; central-station service enables one to avoid largely both the mental and physical strain of the isolated power plant.

Between the continual rise in the price of coal, the occasional interruption of the supply by strikes of miners or of railroad workers and the activity of inspectors in enforcing the ordinance for smoke prevention, the annoyances of the power plant are far greater than the value of the power in the product warrants.

Then there is the unreliable or dissolute engineer whose absence from his post or whose carelessness may result in expense as well as annoyance; the incompetent engineer need only be mentioned.

Coal represents nearly 50 per cent of the cost of service in such plants as are under consideration; labor, 25 per cent to 30 per cent, and both these items are increasing. Central-station rates, however, do not increase, the tendency is always down; the two items named play an insignificant part relatively in the energy costs.

The liability factor in a present-day isolated power plant is an item to be considered, and, other things being equal, to be avoided; true, insurance may be had for the financial risk, but it will not eliminate the personal strain of such events.

The steam-generating plant is a fixed quantity, business is not; the greater the ability of the proprietor the more likely it is to increase. With increase of business the engine and generator must give place to larger ones, involving a loss in the change, a loss in business by reason of a shutdown, together with much trouble, all of which is saved by central-station service.

There is no occasion to change motors with an increase in plant, if the distribution system was properly laid out in the first instance; with more floor area add more machinery and more motors, without interruption to the original plant.

In any generating plant the best economy is obtained when the engine and generator are properly proportioned to the load; in installing a new isolated electric distribution there is considerable uncertainty as to the generating equipment to provide.

Owing to the possibility of saving so large a proportion of the friction load the variation in the load on the engines will be greater in most plants; this condition works to the disadvantage of any but large plants, where the variations in load will result in a fairly stable average.

All uncertainty on the point of generating equipment is avoided by utilizing central-station service; the advantages gained may be specified as: the advantages or disadvantages of central-station service will be practically demonstrated; the actual cost of such service will be learned; actual and positive data will have been obtained as to the generating equipment required, should the decision finally be made after a year's trial run to install it; the investment will have been deferred for a considerable period and advantage taken of improvements in apparatus.

The freedom of action allowed the customer where the central station negotiates open contracts of this sort results in vesting a decided moral advantage with the solicitor in seeking the business. There is oftentimes a very stubborn hesitancy on the part of a prospective motor user to tie himself up for a term of years to an uncertain and, to a certain extent, unlimited, obligation; estimates of energy cost presented by the solicitor are to him little more than guesses, but by omitting the fixed-time feature of the contract, leaving him free to install his own generating plant whenever he sees fit, after a fair trial of central-station service, his fear of being tied up to a disastrous contract is disarmed and he is more open-minded to the merits of the case. Such a policy, too, puts the central station in a measure under bonds to keep its service at the point of highest efficiency, which in itself is an advantageous feature.

This presentation is not theory, but the result of experience with the method, the writer having assisted in securing contracts for motor service that would not have come to the central station on any other basis, and he recalls but one customer who afterward installed his own generating plant.

TABLE VII.—VARYING LOAD COSTS, STEAM PLANT.

	PROPORTION OF LOAD.				
Items.	1.00	.75	.50	.25	.125
Coal	$2,510	$2,000	$1,560	$936	$624
Engineer and helper	1,560	1,560	1,560	1,560	1,560
Water	245	205	160	100	65
Ashes, removal of	85	70	50	30	20
Supplies	100	100	100	100	100
Depreciation	500	500	500	500	500
Repairs	150	150	150	150	150
Interest	250	250	250	250	250
Insurance	50	50	50	50	50
Taxes	50	50	50	50	50
Rental	300	300	300	300	300
Total annual cost	$5,800	$5,235	$4,730	$4,026	$3,665
Ratio annual cost	100	90.3	81.6	69.4	63.2
Net motor hp	77	56	34	12	..
Cost per hp-year at motor pulley	$75.32	$93.48	$139.18	$335.50	?
Kw hours per month	18,418.4	13,395.2	8,132.8	2,870.4	..
Cost per kw-hour, cents	2.62	3.25	4.84	10	..

TABLE VIII.—VARYING LOAD COSTS, CENTRAL STATION.

Kw-hours per mo.	18,418.4	13,395.2	8,132.8	2,870.4	500.†
Cost per kw-hour, cents	2.62*	2.60	3.10	4.40	10
Cost per hp-year at motor pulley	$75.32	$74.63	$88.94	$126.31	$295.60
Total annual cost	$5,800	$4,179	$3,024	$1,516	$600
Total annual cost, 20 per cent added	6,960	5,015	3,629	1,819	600

*This rate is used because of the assumption of equal full-load costs; as a matter of fact the price schedule used for other loads gives a rate of 2.50 cents.

†This is what the minimum charge would pay for at the flat rate of 10 cents per kw-hour; if the flat rate was less the amount available would be correspondingly increased.

Coming now to particulars as to the cost of service in a plant having electrical distribution and using an ordinary maximum of 100 ihp, as against central-station service for the same motor distribution; like conditions are to prevail as to load, also the cost of service in both cases under full-load conditions is to be the same. Assume that the motor distribution has been so well laid out as to obtain a running load factor of about 80 per cent and that the energy price scale is fairly representative as to flat rate and as to discounts.

Considering the physical factors influencing cost rather than dollars, the inquiry is now as to how a varying load affects the cost of energy.

Quantities will be as follows: Price of coal, $3 per ton; use at full-load, 3 lb. per hp-hour; engine efficiency, 88 per cent; generator at full-load, 90 per cent; three-quarter load, 89 per cent; one-half load, 88 per cent; one-quarter load, 80 per cent; one-eighth load, 55 per cent; investment for engine, generator and switchboard, $5,000. Operating costs are to be distributed similarly to those previously stated for the steam plant.

With a total friction load of 23 hp and the motors operating

on an average of 80 per cent load factor, there will be 96 hp in motors. With 75 per cent to 80 per cent load factor the average motor input should be about 920 watts per horse-power.

With the isolated plant indicating one-eighth-load no power is available, as all is used in friction, although the cost of running would be 63.2 per cent of full-load cost—that is, $3,665 per annum—while in the case of central-station service the minimum charge would be, say, $50 per month, which would allow of running a 2.75-hp motor 10 hours per day, at the usual flat rate of 10 cents per kw-hour.

On page 1360 is presented a curve sheet upon which is plotted the partial load costs in each case; the quantities are as found in Tables VII and VIII. The full line of central-station costs results from applying a price schedule now used by a large central station, in which the flat rate is 10 cents, and by extending the discounts to 75 per cent. Even with costs 20 per cent higher, as shown by the broken line, the comparison is still favorable, because scarcely any manufacturing plant will average three-fourths of full-load for the entire year and the broken line crosses the line of isolated plant costs at 76.5 per cent of full load.

With an isolated plant, steam or steam and electric power, a manufacturer is under heavy bonds to run full time and full power, otherwise his "power" cost mounts up rapidly.

The above illustration of the difference in power costs on partial loads is conclusive. Strangely enough, little attention seems to have been given to the situation, a case usually being on the basis of full-load, although full-load is the exception.

With anything like equal costs at full-load, the central station gains rapidly in comparison as the plant load factor decreases, provided the distribution system has been so well laid out that the running load factor of each motor is maintained at a high point, otherwise much of this advantage is lost. The situation affords an elegant illustration of the advantage to a central station of having its customers' plants properly installed

The Prevention and Removal of Boiler Scale—VII.

By W. H. Wakeman.

ONE of the best ways known to engineers for preventing the formation of scale in steam boilers, and incidentally for removing what has already formed on the shell and tubes, is to purify the feed water before it goes into the boiler, thus eliminating everything that can add to the deposit already there, in the case of an old boiler, and making it impossible for scale to form in a new one. This is accomplished in some cases by the use of a filter, which removes certain impurities either before or after the feed water has been pumped through a heater, according to conditions.

Fig. 1 illustrates one of these filters in which water to be purified enters at the right-hand side, and passing downward, as shown by the arrows, is forced through the filtering material, consisting of Turkish toweling or linen Terry stretched over circular sections of bronze lattice work. As the impurities collect on the outer surface of the linen Terry supported by the metal work, it is an easy matter to cleanse it and use it many times over. Some of the more easily separated and heavy impurities settle to the bottom of the large chamber shown, and are blown into the sewer through the lower outlet. The purified water passes out of the left-hand outlet to the boilers.

With every kind of filtering system it is necessary to provide for cleaning the filter while feeding the boilers, provided the plant is run continuously. It requires only a few minutes to clean a filter, but accidents resulting in delays are as liable to happen here as elsewhere, hence it becomes necessary to make arrangements for continuous feeding. With the filter shown in Fig. 1 this is accomplished as follows: The right-hand valve stem is raised as high as possible, thus not only opening the lower passage as indicated by arrows, but at the same time closing the upper passage. When this stem is screwed down the lower passage is closed while the upper is opened, thus allowing water to flow through the horizontal chamber at the top of the filter. The left-hand valve stem is also turned down as far as possible to prevent water from backing up to the filter. This allows the boilers to be fed while the head at the right hand is taken off, the filtering material removed, cleaned and returned. An extra supply of linen Terry ought to be kept on hand in order to facilitate the cleaning process, as one set can be thrown out and a new one put in with the least possible delay. The former can then be cleaned at leisure, and put in place whenever the filter requires cleaning again. This is determined as follows: Two pressure gages are attached to the outer casing, one of which indicates pressure at the inlet, while the other shows it at the outlet. The difference between them represents friction due to the filtering process, and when this is between 20 lb. and 25 lb. the linen Terry needs cleansing. A duplex gage can be used for this purpose. By the use of two separate instruments, the engineer is less liable to mistake their comparative readings.

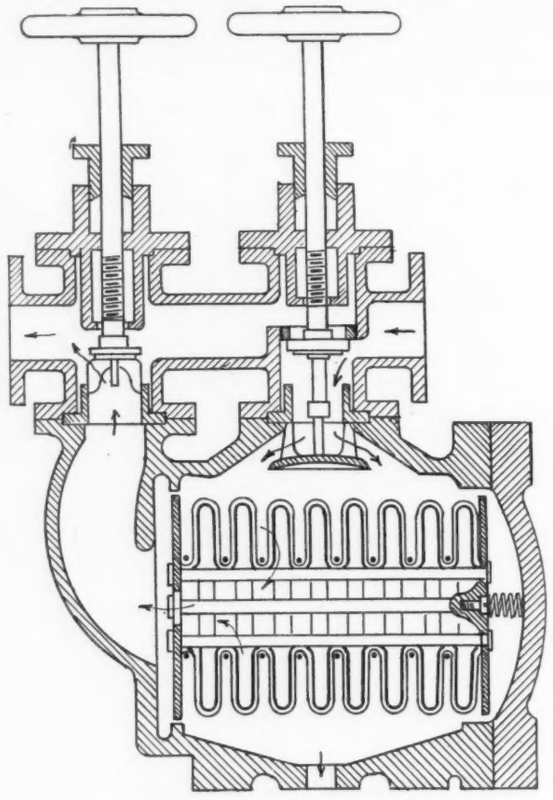


FIG. 1.—FILTER FOR CONTINUOUS FEEDING.

The disadvantage of continuing the feeding process while the filter is out of use is found in the fact that impure water must be used during this time, hence there is a point in favor of shutting down the feed pump until the filter is ready for service. This statement applies to plants that are fitted with tubular boilers, or others which hold a large body of water, thus permitting the feed to be shut off for 20 to 30 minutes. It is out of the question in plants where certain kinds of water-tube boilers are in use, as they do not hold enough water to make the plan practicable. To demonstrate this point a certain engineer filled his water-tube boiler to the top of the water-gage glass, shut down the feed pump and noted the result. In three minutes the water level was down to the bottom of the glass, thus showing the necessity of continuous feeding.

If the feed water is very impure it is advisable to install two filters, each of which is of sufficient capacity to purify the maximum quantity of water required, provided the plant is operated 24 hours per day. This is not necessary in a shop that is run 10 or 12 hours, as the cleaning operation can be done by an assistant engineer while the plant is shut down.

It is practicable to cleanse this filter partially and thus prevent

the friction from rising above 10 lb. or 12 lb. until an opportunity is presented for giving it a thorough cleansing. It operates as follows: With the boiler feed pump in operation, both of the valve stems shown are turned down as far as possible, and a drip valve, the outlet to which is shown at the bottom of the large chamber, indicated by an arrow, is opened. The right-hand valve is then opened slightly, allowing water to circulate over the outside of the linen Terry, washing off a portion of the impurities and discharging them through the drip valve. By closing the right-hand valve and opening the left-hand valve, water is caused to flow opposite to the direction indicated by the arrows. As it now enters the filtering sections of bronze covered by the linen Terry, and flows outward into the chamber, it washes off more of the impurities and disposes of them.

Fig. 2 illustrates another filter that is worthy of consideration. While the valve stem is turned upward as far as possible in the position shown, water from the feed pump enters the inlet chamber 2, flows upward as indicated by arrows, passes thence to the filtering chamber in which are located several cylinders, or cartridges, which retain impurities, but allow clean water to pass into the lower chamber, and thence to the outlet chamber 3. These cartridges consist of two perforated, brass, concentric cylinders, the smaller of which is expanded into the bottom of the filtering chamber. Linen Terry is drawn down over this

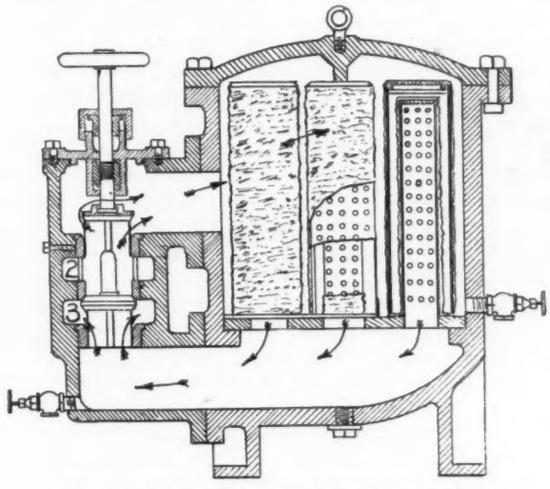


FIG. 2.—FILTER WITH CLEANSING CARTRIDGES.

cylinder, which is in turn covered by the larger cylinder. The linen is then drawn upward until it completely covers the cylinder and a brass cap is fitted over the ends. From this it is plain that water is filtered twice by each cartridge.

A pressure gage is fitted to the filtering chamber, and another to the outlet. The difference between them indicates the condition of the filter, and when it requires cleaning, the valve stem is turned downward, thus bringing the upper disk down to its seat and at the same time releasing the lower disk from its present position and bringing the lower surface of it into contact with the lower seat. The result is that water flows from the inlet passage 2 directly to the outlet 3. Bolts are removed from the cap, and it is lifted off by the eyebolt shown. The outer cylinder of each cartridge is removed, together with the linen Terry, which is replaced by clean linen covered by the larger cylinder, and when the cap is replaced the filter is ready for use.

The double-beat valve is designed to overcome objections to this style of valve as usually constructed, as the two disks are not rigidly connected, hence neither expansion nor contraction of the stem due to changes in temperature can affect the seating of the valves.

When a closed feed-water heater is used the filter must be placed between the pump and heater, thus removing impurities before they go into the heater, and preventing the formation of scale on the tubes or coils of pipe, which will lower the efficiency of the heat-transmitting surfaces. With an open heater this is impractical because water flows into such a heater from external pressure, and after it is duly heated it gravitates to the pump by which it is forced into the boiler. If water is taken from street mains the pressure is frequently sufficient to force it through a filter if desired, but as a general rule an open heater of modern design is also a purifier, hence no separate filter is required.

Fig. 3 illustrates a filter that is fitted with an independent by-pass, to be used when the filtering material must be cleansed. While in regular service water enters the inlet valve 2 and is discharged into the filter chamber 3. Oil and other light impurities rise into the scum chamber shown, which is fitted with a glass gage to show when it is necessary to blow it out through the cock at the top. Just below the filtering chamber and forming part of it is a pocket for catching heavier impurities. It is provided with a blow-off cock. Four perforated metal plates are provided between the chambers 3 and 4 and between these plates woven filtering material is placed to prevent impurities from passing into 4. The metal plates are provided to prevent the cloth from bagging and becoming ruptured by the passage of water after more or less impure matter has collected on it. A hinged door is provided just above these plates, and when it

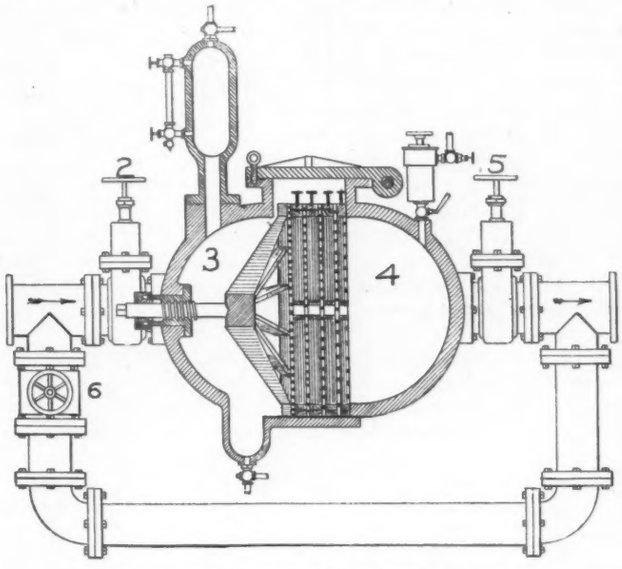


FIG. 3.—FILTER WITH INDEPENDENT BY-PASS.

is wide open the plates can be removed by means of a handle attached to each, new cloth put in and the whole replaced in a few minutes. A cup is provided at the upper part of 4 into which soda is introduced, and when steam is admitted through the angle valve dissolving the soda and blowing it into 4, it cleanses the surfaces and discharges the resulting impure matter through the blow-off cock to the sewer. Pure water passes from 4 through the outlet valve 5 and thence to the heater, as indicated by the arrow. When it is necessary to feed the boiler while cleaning the filter, valve 6 is opened to allow water to flow through the by-pass, but valves 2 and 5 are closed.

Analysis of matter left in a filter showed that more than one-half of it consists of tallow, organic matter and mineral oil, therefore if these were allowed to go into the boilers they would form a very destructive scale, endangering the life of the boiler and greatly increasing the consumption of fuel for a given weight of water evaporated. Such impurities are not always classed under the head of scale-forming matter, but they belong in this class because the sediment resulting from the application of heat to them is a very efficient non-conductor, hence many boilers have been seriously damaged by such accumulations. It is generally not a hard scale, and sometimes it is not easily recognized by an inexperienced engineer as the direct result of allowing oil and grease to go in with the feed separator, or the absence of a filter in plants where the exhaust water, as it appears dry and hard, but it is due to an inefficient separator, or the absence of a filter in plants where the exhaust steam is condensed and returned to the boilers.

LETTERS ON PRACTICAL SUBJECTS

SIDE TROLLEY FOR INDUSTRIAL LOCOMOTIVE.

The following description of a little trolley device may be of interest to some of the *Electrical World* readers: Not long ago the writer had occasion to use an electric locomotive of the industrial type, on a piece of track belonging to the steam road,

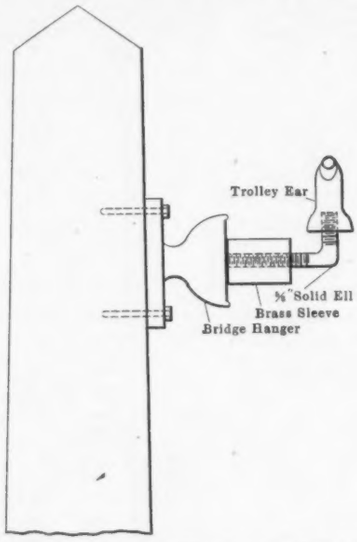


FIG. 1.—ARRANGEMENT OF TROLLEY EAR.

which fortunately was operated by the same company who owned the electrical equipment. It was therefore easy to obtain consent to run the electric locomotives over the steam line, provided a trolley could be arranged that would not interfere with the steam cars. Obviously the ordinary trolley line construction would not do, as the wire would be so low the steam locomotives could not operate. The wire was therefore suspended parallel to the track, about 15 ft. above the rail and 10 ft. to the side. Over this wire the trolley traveler was made to run on top, the trolley ears being inverted and held thus by a bridge hanger, brass sleeve and steel elbow, as shown in Fig. 1. The traveler was constructed from two trolley wheels, three ⅛-in. x 1-in straps, an 8-lb. sash weight and three suitably shaped steel pins. It is shown in Fig. 2. A cable was soldered to the traveler, and by tying the locomotive trolley

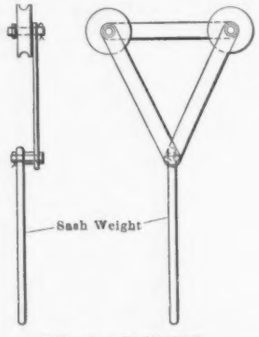


FIG. 2.—TRAVELER.

pole down, and hooking the loose end of the cable into the harp, the locomotive could proceed onto the steam road and "go on its way rejoicing." The above-described device has been in successful operation for over two months, and already has paid for itself many times by eliminating team work which was formerly necessary, to say nothing of time saved and the convenience all around.

Copperhill, Tenn. Jas. T. Watson.

COST OF HANDLING COAL AND ASHES.

At first sight, it seems as though the comparatively small amount of labor and power required to bring fuel to the boilers and to convey away the ashes could be regarded as negligible. When it is realized that fuel is yielding as useful work only about 5 per cent of its actual heat value, then it is in order to take great care that none of these five units saved from every hundred be expended in doing useless work. It costs money to handle coal and ashes; therefore, they should be handled as cheaply as possible, and notes made as to the cost of handling by various methods in order to determine which is profitable and which is too costly to use. As an example, consider the coal and ash-handling proposition of a power plant which consumes 10 tons of inferior fuel per day of 24 hours and also handles ashes to the amount of 20 per cent of the fuel, or 2 tons. The coal is received from a canal boat by means of a clamshell bucket and hoisting rig and deposited in a building on the dock, level with the boilers and 100 ft. distant therefrom. The fireman wheels about 200 lb. at a time and consumes one minute in loading, one minute in wheeling the coal 100 ft., another minute in returning to the coal pile, and one more minute—and sometimes several of them—in dumping his barrow-load. The total time of each 200-lb. barrow-cycle is, then, equal to four minutes, or 15 loads per hour. At 220 lb. per load, 1½ tons will be handled per hour. As there are 2 tons of ashes to wheel out as well as 10 tons of coal to wheel in, the total daily load to be handled is 12 tons. At 1½ ton per hour, it is evident that eight hours will be required for the work, and calling this a day's work at $1.50, the cost of handling coal and ashes manually will be 10 5/12 cents per ton.

Next, let there be considered the cost of handling the coal and ashes by means of a pivoted-bucket conveyor. This installation is to pass over the boilers and the coal and ash storage, also pass underneath each, in order to receive either substance by gravity, and also to discharge either by the same method. The cost of such a conveyor will be found to approximate $1,800 and to require from 5 hp to 7 hp for its operation. The capacity of such a conveyor would be about 8 tons per hour, hence about 1½ hour's operation will be necessary to handle the stated amount of coal and ashes. In order that the fireman may operate the conveying device without neglecting his other duties there must be installed the necessary coal and ash hoppers, which will make the entire system automatic save for the manipulation of the necessary levers and slides by the fireman. The cost of the necessary hoppers, excavations and the installation of the plant may be taken at $2,800. The cost of the conveyor will be about $1,800. The cost of the motor for driving it may be taken at $500 installed and connected. Or the same amount may be allowed for driving the conveyor by means of an engine. If the conveyor can be driven by belt from the main engine, the cost will fall slightly below $500, but not much, and that sum had best be allowed under all circumstances. The total cost is thus $5,100, and the interest, taxes, depreciation and repairs on this investment may be taken at 21 per cent, amounting to $1,071 per year. If operated 365 days in the year this means an expense of about $2.94 per day in addition to the energy required, against $1.50 for doing the same amount of work manually.

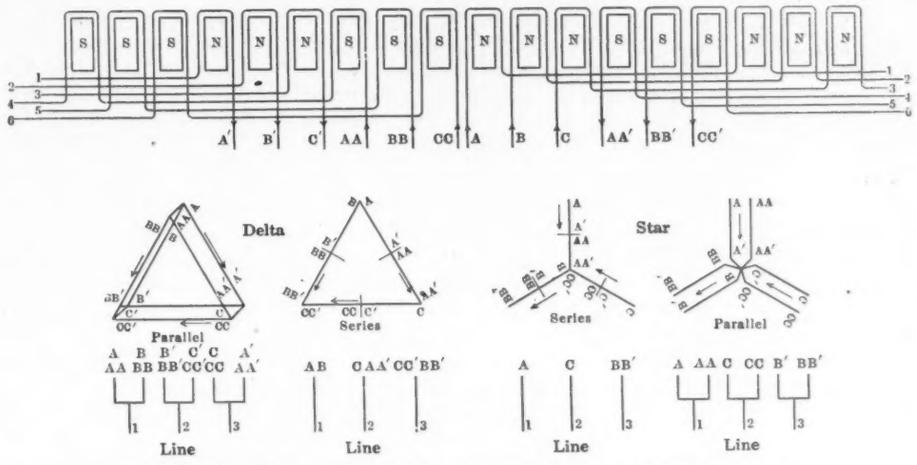
It is evident that it will not pay to use conveyors for so small an amount of coal. But it is further evident that the conveyor can easily handle 10 times the amount of material now handled with it. This would materially reduce the cost when the larger quantity of 120 tons per day is handled. Therefore, when considering the installation of labor-saving appliances, the engineer should make sure that the labor is there to be saved. Sometimes it costs more to save than the saving can possibly amount to. For instance: A fuel economizer will work just as favorably in a little plant as it will in a large one, and it will save the same percentage of fuel; but who wants to save 10 per cent on $10 worth of coal a day by means of an installation costing $5,000 to $6,000? It is the same way with the coal and ash conveyor. It doesn't pay to consider such an installation until its cost falls below 10 cents per ton of material handled.

It may also be interesting to view another phase of the ash-handling problem. In this instance, the boilers are supposedly located in a cellar or a basement, and all the ashes must be hoisted or elevated to the street level and placed in a cart for removal. Here, two methods will be compared: the use of a rope or chain tackle for hoisting the ash buckets, and the handling of the same amount of material by means of a bucket elevator. To this there may be added, if desired, the comparison of doing the same work by means of a "sidewalk elevator," which is an adaptation of the regular platform freight elevator except that it travels only about 10 ft. a minute.

With the hand-operated tackle handling 2 tons of ashes in 200-lb. ash-buckets from a 14-ft. cellar, the cans to be hoisted high enough so that they may be easily dumped into a horse-drawn cart. The matter of power expended in doing the work does not enter, but the matter of time is a very important one. It will require two men to hoist the ash cans, and they can pull about 12 in. of rope at a pull, raising the can 3 in., and requiring about one minute to make 70 pulls on the hoisting rope. Therefore, the velocity of the can is about 17 ft. per minute, or 1.14 minutes for making the 20-ft. trip. Add the necessary time for dumpting the can, lowering the empty can and attaching a loaded one to the hoist and the time has been extended to at least four minutes. But the services of two men are required to do the hoisting. Another man is necessary to dump the cans into the cart, but this can be attended to by the driver. Likewise, the attaching of the full cans and the removal of the empty ones will be attended to by the fireman without extra cost for his time. The cost of the equipment is less than $100. To remove 2 tons of ashes in 200-lb. loads at four minutes each requires 80 minutes' time, to which will be added 10 minutes for getting ready and for cleaning up after the operation, making the time required 1½ hours for two men, or three hours at 15 cents = 45 cents. Add to this the cost of the equipment and the total cost is less than a dollar.

With the bucket elevator, either made as a permanent fixture or to extend itself above the sidewalk when required, the investment will represent, including motor drive, about $400, and it will be required to lift 4000 lb. 20 ft. high with 25 per cent added for friction and other losses, or an equivalent load of 5000 lb. The time for elevating the 2 tons of material will be taken as 20 minutes, allowing 10 minutes more for getting ready and cleaning up. Thus there is one-half hour in which 5000 lb. is to be raised 20 ft. high. The time cost is very slight. The fireman works the lower end of the combination and the driver has nothing to do but to trim the ashes as they fall into his cart for a half hour or so. The bucket elevator holds the driver but 30 minutes, while the hand-hoist requires his presence and that of his team for 1½ hours—a saving of one hour in favor of the bucket elevator. The cost of operation is much less also. In the examples above it is interesting to note that hand labor proves the cheaper in one most unexpected place, while machinery beats hand labor in another place where at first sight there does not seem any chance for a saving.

SOUTH BEND, IND. JAMES F. HOBART.


S S S N N N S S S N N N S S S N N N
1 2 3 4 5 6
A' B' C' AA BB CC A B C AA' BB' CC'
Delta
Parallel
Series
Star
Series
Parallel
A B B' C' C A' AA BB BB CC CC AA'
AB CAA' CC' BB'
A C BB'
A AA C CC B' BB'
1 2 3
Line

CONNECTION DIAGRAM FOR STATOR OF A THREE-PHASE INDUCTION MOTOR.

STATOR CONNECTIONS FOR THREE-PHASE MOTORS.

Oftentimes an electrician who has not had very much experience with the internal connection of an induction motor is called upon to rewind one of these machines. Much time is then lost in studying the proper way of making the connections. In such a case the accompanying diagram will be of much value. It is only necessary to tag the leads in the order indicated in the diagram. When the wiring is finished, it can be connected parallel or series, star or delta, by connecting the tagged wires as indicated in the lower part of the diagram. In removing the burned wire it is quite difficult to trace all the connections; but it is quite easy to determine which of the four ways of connecting was employed. If only one wire is found connected to each line terminal, the stator connection is series star. If two wires are found connected to each line terminal and a jumper having six wires connected to it, the connection is parallel star. If two wires are connected to each line terminal and no jumper has more than two wires connected to it, the stator is wound series delta. If four wires are connected to each line terminal, the stator is connected in parallel delta. In the actual motor the coils lap, while in the diagram they are shown following each other to make connections appear more clearly.

LEAD, S. D. J. F. WIGGERT.

DETERMINING CONDENSER LEAKAGE.

Although the number of surface condensers in use in connection with turbine plants has increased rapidly during the past few years, it is doubtful whether any attempts have been made by operating engineers to determine whether or not the condensers are leaky. The usual practice of builders of subjecting the cooling surface side to hydrostatic pressure, and afterward the condensed-water side, observations being taken to determine whether any water trickles through, usually suffices for the operating engineer. If, however, the latter decides upon a separate test, the condensing plant may be run for several hours with only the circulating water going through the cooling surface, and the condenser watched for water in the condensing tubes. The best test, however, is obtained when the condenser is working under full-load conditions, and where salt water is used for condensing purposes a very delicate chemical test may be applied. By means of silver nitrate, sodium chloride, or common salt, may be readily detected, and, inasmuch as condensed water is ordinarily pure and should not contain salt under any circumstances, if the silver-nitrate test shows the presence of salt it may be taken as indicative of condenser leakage. The test, however, is very delicate, so that the leakage, however slight, is quickly disclosed. A standard solution of silver nitrate may be purchased at any drug store, or may be made by dissolving 2.394 grammes of pure recrystallized silver nitrate in a litre of distilled water. A solution of potassium chromate, made by dissolving one part of potassium chromate in 10 parts, by weight, of distilled water, should be used as a color indicator. The chemistry of the test is that the silver combines with the chlorine in preference to the chromic acid, and no red chromate of silver is capable of formation so long as chlorides are in the water. Red chromate of silver instantly forms, however, the moment nitrate of silver is in the slightest excess. If, therefore, water known to contain salt be treated

by adding silver nitrate solution to it, drop by drop, a white precipitate of chloride of silver will form until all the chlorine in the water has been thrown down. Since, however, the exact point at which the formation of the precipitate ceases cannot be accurately observed, the color indicator, or potassium chromate, may be used to determine this state. For the purpose of giving detailed information on the process of conducting such a test the following may suffice: 50 cu. cm of the condensed water should be passed through ordinary filter paper into a clean porcelain dish, and while stirring the water a few drops of potassium chromate should be added. The color will be found to be distinctly yellow. If, then, the silver nitrate solution be carefully dropped from a graduated burette, drop by drop, and the water constantly stirred, the first few drops will become red the moment they touch the water and disappear or fade into a pale yellow on stirring if salt be present. The application of silver nitrate solution should be continued until the water becomes permanently red, and at the very first moment at which the chromate of silver begins to form, or the redness of the solution persists, the addition of silver nitrate should be stopped and the amount used be determined from the graduated burette. This serves as an indication of the quantity of salt present in the water. A cubic centimeter of silver nitrate solution practically corresponds to a grain of salt per gallon of water, so that if the first one or two drops of silver nitrate solution causes the water which has already been treated with the potassium chromate to become permanently red, it is quite certain that there is little or no salt in the water. If, on the other hand, a number of cubic centimeters of silver nitrate solution are required to obtain a permanently red color, the condenser is leaking, and the quantity of salt found to be present will serve as a guide to the extent of the leakage.

Chicago, Ill. Henry Frank.

ELECTRIC THAWING OF WATER PIPES.

The following data on thawing water pipes is written up from notes taken during the months of January and February of this year on work done in a town of about 2500 population, located in the Cascade Mountains, in Washington. The town has a gravity water system. The mains are wood stave pipe

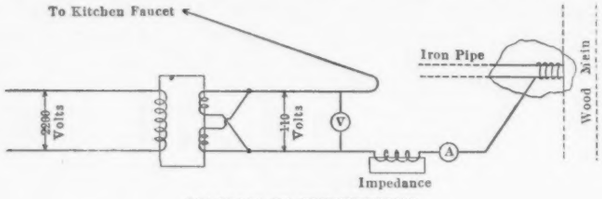


DIAGRAM OF CONNECTIONS.

with branches of 2-in. iron pipe. Energy for thawing the pipes was obtained from the lighting circuit. In some cases connections were made directly to the pole line secondary circuits, while in others a transformer was placed on a sled and a few hundred feet of primary wire run, a No. 12 rubber-covered wire being used for this purpose. The wires were simply laid one at each end of the top cross-arm. Two nails driven at each end of the arm kept them from fouling or falling. The air being clear and dry no insulation other than the wood and rubber covering was necessary.

Besides the transformer the sled was equipped with an impedance coil for regulation, a 500-ft. coil of No. 2/0 weatherproof wire and a quantity of No. 4 scrap wire in about 200-ft. lengths. The impedance coil consisted merely of 20 turns of No. 2-0 wire wound on one leg of the core of a 15-kw transformer, which was burned out by lightning the preceding summer. The equipment of instruments was quite unsatisfactory, the only available ammeter being a switchboard-type instrument reading to 150 amp and a voltmeter with a scale reading to 150 volts. The ammeter had to be short circuited in a number of cases and not infrequently an incandescent lamp was the only voltmeter obtainable. The instruments were in good repair and correct within 2 per cent.

The mains being wood pipe it was necessary in every case to dig down to where the iron pipe entered the main. The pipe was carefully cleaned at this point and connection made with several turns of No. 6 wire. The other connection was made at some exposed portion of the pipe, usually at the kitchen faucet, the wire being wrapped around the faucet, insuring a good copper to brass connection. The streets being packed with snow and ice to a depth of a foot or more, no attempt was made to insulate these secondary wires. Owing to the limited current-carrying capacity of the apparatus it was necessary in a few cases to thaw out the pipes in sections, first thawing from the main to the cut-off just inside the yard, then from the cutoff to the kitchen faucet.

The apparatus and connections are shown in the sketch herewith. The method of recording data is shown in the example below, which is a copy of the notes taken on the fourth job done:

(Name.)		(Location.)			(Date.)
C. F. Jones.		1147 First St. E.			1/24/09
Workman.	On.	Off.	On.	Off.	Total time.
B.....	1:30	2:30	....	....	1
S.....	1:30	2:30	....	....	1
C.....	1:30	2:30	....	....	1
W.....	1:30	2:30	....	....	1
Current.....	2:10	2:20	....	....	1/6

Amperes, 100; volts, 120; kw-hours, 2.
Remarks: Size of pipe, ½ in.; length, 125 ft.
Connections made at toilet in rear of lot and at main. This man had already spent $12, with no results. Had all faucets running 10 minutes after current was turned on.

Following are abbreviated records of a few other jobs:

HOTEL, 43 P ST., JAN. 31, 1909.

Workmen, total time, 5½ hours.
Current on, total time, ⅓ hour.
Amperes, 140; volts, 130; kw-hours, 6.1.
Remarks: Size of pipe ½ in.; length, about 60 ft. Connections at main and at cut-off in store on first floor. Connected to 15-kw transformer on nearby pole. Pipe covered with 1-in. packing. Pipe was burst behind range in kitchen and behind heater in chamber. Taped up leaks and left water running on first and second floors.

E. P., FIRST ST., E., JAN. 24, 1909.

Workmen, total time, 10 hours.
Current on, total time, ¾ hour.
Amperes, 90; volts, 130; kw-hours, 8.8.
Remarks: Size of pipe, ½ in.; length, about 75 ft. No results. Pipes were taken up next day and found plugged with sawdust and shavings.

F. W., FIRST ST., E., JAN. 24, 1909.

Workmen, total time, 12 hours.
Current on, total time, ½ hour.
Amperes, 120; volts, 120; kw-hours, 7.2.
Remarks: ½-in. pipe, 125 ft. in length. Left water running in kitchen.

M. C., FIRST ST., E., JAN 28, 1909.

Workmen, total time, 4 hours.
Current on, total time, ¼ hour.
Amperes, 120; volts, 130; kw-hours, 3.9.
Remarks: ½-in. pipe, 120 ft. in length. Pipes frozen under kitchen.

H. W. T., THIRD ST., W., JAN. 30, 1909.

Workmen, total time, 4½ hours.
Current on, total time, 2/3 hour.
Amperes, 110; volts, 120; kw-hours, 6.6.
Remarks: Pipes, ½ in. Length, about 100 ft. Connections at main and faucet on second floor. Pipe burst 6 in. below first floor ceiling. Taped up and left water running.

STORE, COR. 1ST AND P STS., JAN. 28, 1909.

Workmen, total time, 5 hours.
Current on, total time, ½ hour.
Amperes, 175; volts, 115; kw-hours, 10.1.
Remarks: About 75 ft. of 1¼-in. pipe feeding water motor on coffee grinder. Connections at main and at motor.

CITY, COR. FIRST ST., E., AND P ST., JAN. 25, 1909.

Workmen, total time, 7 hours.
Current on, total time, ½ hour.
Amperes, 150;, volts, 130; kw-hours, 9.8.
Remarks: 100 ft. of 2-in. pipe. Connections at main and at valve in street.

SAME.

Workmen, total time, 6 hours.
Current on, total time, ½ hour.
Amperes, 60; volts, 130; kw-hours, 3.9.
Remarks: Connections at valve in street and at faucet in saloon. About 30 ft. 2-in. pipe and 50 ft. ½-in. pipe. Left all valves open in street and left water running in saloon.

CITY, COR. FIRST ST., E., & T. ST., JAN. 26, 1909.

Workmen, total time, 16½ hours.
Current on, total time, 4½ hours.
Amperes, 90 for 1¾ hours; volts, 100; amperes, 160 for 2¾ hrs; volts, 93; kw-hours, 56.8.
Remarks: Had to run 500 ft. of primary. Connected at valve in street near main and at fourth house from corner. No results. Changed connection from fourth to first house at kitchen faucet. Water in one hour, but very little pressure. Valve was frozen solid in street, but opened 20 minutes after current was on. About 120 ft. of 2-in. pipe and 75 ft. of ½-in. pipe.

SAME, JAN. 27, 1909.

Workmen, total time, 14 hours.
Current on, total time, 4½ hours.
Amperes, 100 for 1½ hours, 130 for 3 hours; volts, 110; kw-hours, 59.4.
Remarks: About 30 ft. of 2-in. pipe was burst and flooded street when the frozen ground was dug away from it.

The meter readings were taken a few minutes after the power was turned on. There was very little variation in the

current after it was once steadied. The increase in resistance of the pipe, due to the increase in temperature, was hardly appreciable. In no case did the pipes reach more than a lukewarm temperature. A rough means of determining the relative temperature was to throw a little snow on an exposed part of the pipe and watch it melt.

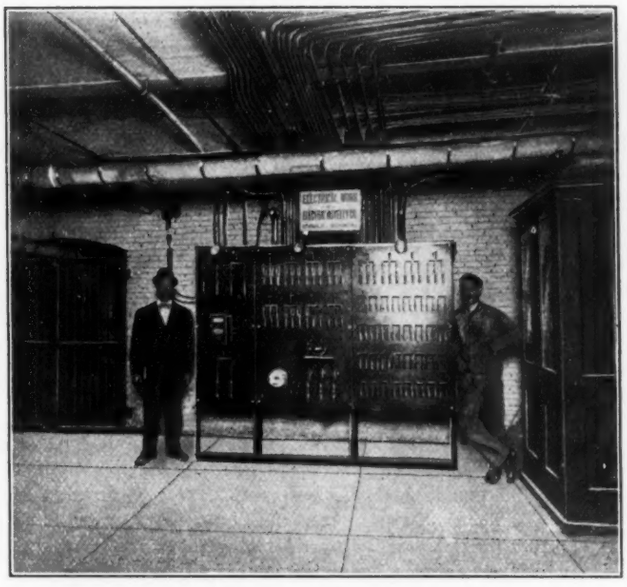
From the above examples it is readily seen that to determine a charge per length and size of pipe would be quite unfair. To charge according to time and energy used would have made great variations in the customers' bills and would probably have led to difficulty in collecting. After the first few jobs the following rates were decided upon and proved very satisfactory:

Charge for thawing ½-in. pipe	$6.00
Charge for thawing ¾-in. pipe	8.00
Charge for thawing 1-in. pipe	10.00

For 1¼-in. pipe and larger a time-and-energy charge was agreed upon. Time was charged at the rate of $1.75 per hour for fireman and helper and energy at the rate of 10 cents per kw-hour. Except when lowering a transformer to the sled two men could easily take care of the work.

The income from the work mentioned in the above examples averaged a little more than $8 per day above all expenses. As there was no initial investment in apparatus and practically no depreciation this was all clear gain.

It will be noticed that most of the work was done on one street. This was because the street was filled in with gravel



REMODELED WIRING INSTALLATION.

and the frost penetrated it easily. Roughly estimating, about one out of every four houses on this street had frozen pipes.

ROSLYN, WASH. EDWARD M. BROOKS.

REMODELING A WIRING INSTALLATION.

The illustration above shows a picture of a new switchboard installed in the Custom House at Memphis, Tenn. The board was designed especially to suit Custom House needs and the remodeled installation will doubtless interest readers. The board was made in three panels of extra heavy slate and two panels carry the electric light switches and fuses and also the lamp meters and transformer. One panel takes care of the motor circuits and the motor meter. Each panel is lighted by an independent lamp. The board as a whole is securely anchored to the concrete floor and to the brick wall, and the front is highly polished. A 300-amp triple-pole switch controls the entire installation. The building was rewired and remodeled prior to the installation of the board. Wide brick walls had to be penetrated, heavy plaster cut and the heavy pine flooring removed so as to obtain passageway for the conduit. Ten large subcabinets control the circuits on the three floors. The lighting fixtures were all grouped and rebalanced so that the increase in the number of circuits was over 100 per cent. The Post Office fixtures are controlled by individual flush switches. Curiously enough, with the new wiring the drop in voltage was smaller and the lamps burned more brightly.

MEMPHIS, TENN. F. M. PALMER.

COOLING TOWERS NEAR CULM BANKS.

The great culm banks which surround the mine openings in the anthracite coal regions have usually been looked upon by persons not fully acquainted with all the conditions as ideal sites for the generation of electricity, because the culm can be obtained for little or nothing. Although grates have been devised for burning this cheap fuel, the problem which confronts the operator of a plant located on such a site is to obtain water. The water that is used in the mines and in the breakers, and finally finds its way into small streams, is so charged with dirt and sulphuric acid as to render its use for boiler-feed purposes impossible. In fact, if an ordinary coal shovel were thrown in the water and the site revisited in a year no sign of the shovel could be found, the iron having been completely dissolved by the acid in the water. In not a few locations the water is very much more expensive than the fuel, so that while ordinarily one would expect that power plants located where fuel is cheap could manufacture electricity at a very low cost, such is not the case, a kw-hour of energy being manufactured in large cities remote from the coal fields for considerably less oftentimes than it is manufactured in the mining plants. As a result of the scarcity of water, most of the plants located in the coal regions operate non-condensing. This practice is also partly due to the cheapness of fuel. However, with the use of a steam turbine the best economy is obtained when the plant operates condensing. Despite the cheapness of fuel, it is possible to realize a marked economy with simple engines if these be operated condensing. The problem, however, is to obtain the necessary water for this purpose, and it is surprising that more use is not made of the cooling tower for husbanding the supply. Plants already in operation using circulating water drawn from muddy streams, carrying grit and sand, avoid the cutting of pump pistons and cylinders by using cooling towers. The water coming from the condenser in a heated condition is spread out in such a way as to bring the greatest surface in contact with the greatest quantity of air, so that evaporation takes place quickly and effectively. The cooling tower, of course, does its best work when the surrounding air is dry, but radiation does part of the cooling during the winter season, as does also the contact of cool air with the heated water. Nevertheless, the bulk of work is due to evaporation. Manufacturers of modern cooling towers obtain the necessary circulation by means of fan blowers, and a fan tower is to be commended where the quantity of heat to be removed is great, or where the duty is especially severe in the hot summer months. But the cost of power necessary to operate the fans, and the wear and tear, due to moving parts, has resulted in the production of natural draft fanless towers. The open fanless tower not only dispenses with the fans, but does away with the tank structure entirely. The apparatus is open on all sides to the air, and the natural currents are utilized. Where sufficient ground area is available, as at the mines, this type of tower, which is simple in construction, easy of access and which requires a minimum of attention, should prove efficacious. The tower can be used in connection with either jet or surface condensers, but with the former system an additional pump must be employed to deliver the discharge from the air pump to the top of the tower. A surface condenser is preferable if the tower is located on the roof or otherwise elevated, since the discharge and suction columns balance below the tower, making the work of the pump that due solely to the height of the tower itself. The cooling tower has done much to make feasible the operation of steam engines condensing, in places where the cooling or injection water would ordinarily be too expensive or too scarce.

SCRANTON, PA. JOHN CLARK.

QUESTIONS AND ANSWERS

We have just installed a rotary converter set which pumps very badly and no amount of field adjustment seems to improve operating conditions. Can you suggest a remedy? B. T. A.

Defects of this kind have been overcome by boring out the field structure for a larger air-gap and beveling the pole corners. Copper dampers may then be applied around the pole pieces near the tips. We would suggest, however, that you communicate with the manufacturer of the machine before attempting any remedy.

How are the transformers connected which feed the transmission lines running to Syracuse, N. Y.? S. S. B.

The transformers in the generating station of the Ontario Power Company at Niagara Falls, Ontario, from which the transmission lines passing through western and central New York are supplied, are connected with their low-tension windings in delta and their high-tension windings in star, and step-up the generator voltage from 12,000 to 62,000, the potential at which the lines operate.

What means are taken to prevent the enormous stresses which occur after a short circuit in large 25-cycle generators? T. T.

External reactances are used in connection with some large units of which we have knowledge. These do not affect the regulation appreciably, since this depends on the synchronous impedance which is only slightly increased by the added reactance. The latter is placed in the generator leads and in addition to guarding against mechanical strains protects the generator winding to a certain extent from high-frequency surges from the outside.

How much resistance is usually provided in the field rheostats of direct-current generators? S. N. N.

The field rheostats of direct-current generators are usually designed with resistance approximately equal to that of the shunt field windings of the machines with which they are employed. This will ordinarily allow a range in voltage of over 25 per cent. The resistor is divided into many sections, each of which has a contact point on the face plate. The rheostat must be able to dissipate 25 per cent or more of the field loss continuously without seriously overheating.

Why are the ratings of alternating current units expressed in kilo-volt-amperes instead of in kilowatts? F. F. F.

The kilo-volt-ampere rating does not take into account the power factor of the system to which the alternator is to be attached or under which it is to operate. The output of alternators is limited by the heating and this in turn depends on the voltage and current regardless of the power factor, and hence of the power output. Therefore, a certain generator can be given a definite kilo-volt-ampere rating, but when rated in kilowatts account must be taken of the power factor.

In equipping lighting circuits with potential regulators would the induction type or the step-by-step type be preferable? H. K.

Generally speaking, the induction type of regulator would be preferable to the step-by-step type, since the former is usually automatic in its operation, while the latter is manually operated. The induction regulator used on single-phase lighting circuits effects changes by altering the position of a coil in a magnetic field, and the step-by-step regulator effects a similar result by cutting in and out, by means of taps, sections of the winding of a regulating transformer.

What percentage of voltage variation is usually permitted on lighting circuits feeding carbon-filament incandescent lamps and how will this affect metal filament lamps? G. H.

Edison companies have arranged their circuits for a standard 2 per cent variation of pressure in mains, because of the effect of small differences of potential upon the brilliancy and life of the carbon-filament lamp. Motors and arc lamps give satisfactory service where the fluctuation is twice that which is permitted in carbon-filament lamps. The incandescent lamps having metal filaments do not respond so noticeably to slight variations in voltage.

Can transformers be tested by their own voltage? If so, how is the test made? E. T.

When transformers are used for this purpose, one side of the high-tension winding is connected to the low-tension winding and the iron, and the transformer operated at a potential sufficiently high or above normal to give the necessary test voltage. The other side of the high-tension winding is then connected in the same way and the test repeated. The middle part of the winding, however, receives only half the total test voltage to ground and low-tension coils, there being a uniform grading of test voltage along the winding from the middle point to the outer end.

What advantages are possessed by two single-phase transformers arranged to feed a three-phase load over a single three-phase transformer? W. T. F.

Assuming that two single-phase transformers are connected in open delta to supply three-phase service, the failure of one transformer would interrupt the service until the damaged unit was replaced, and, therefore, this class of installation has no advantage over the three-phase transformer, since in either case a new unit must be provided. With the two-unit method good regulation is not obtained due to the distortion of voltages when the load changes. While this would not be serious on motor circuits, for lamp circuits it would not be desirable.

Should the absence of smoke from a chimney be taken as indicative of complete combustion in the furnace of a boiler? E. E. S.

No. The only way to determine how perfect the combustion is in a furnace is to analyze the escaping gases. To get a fair average and to plot a curve showing what is taking place in a furnace, it is necessary to determine the percentage of carbon dioxide at frequent intervals for about a day or two. An automatic carbon-dioxide recorder will furnish the desired facts regarding combustion, the value of firemen, as well as other information which cannot be secured satisfactorily in any other way. Such an instrument requires little attention and will give quite accurate results. The instrument should be thoroughly understood, however, and the same care and intelligence should be exercised in handling it as is usually accorded to the Orsat apparatus. If treated as an ordinary piece of boiler-room equipment the results will be unsatisfactory.

What effect have variations in frequency upon the performance of watt-hour meters? R. B.

Meters tested on both non-inductive and inductive loads representing 10 per cent variation in frequency, show that for non-inductive loads a 10 per cent variation in frequency has but little effect, the error being materially less than one-half of 1 per cent. On inductive loads, with a 10 per cent variation in frequency and with a power factor of 0.75, the average error was approximately 1.5 per cent and for a power factor of 0.50 3 per cent, the tendency being for meters to run slow on the lower frequency and fast on the higher frequency. In general practice the variations in frequency in normal running conditions tend to make the meters run slow, and as this variation rarely approximates 10 per cent, the error would be less than 1.5 per cent. Variations in frequency of 10 per cent are abnormal.

The oil from the step bearings of two 500-kw turbines oftentimes becomes thick and milky and a change in the oil does not seem to remedy matters, the changed oil becoming just as bad as the other oil after a time. The lubricant is guaranteed by the manufacturer as a pure petroleum distillate with no blending. What should cause the oil to become milky? Does chemical action take place? O. I. I.

The explanation of the formation of the emulsion noticed has been given as follows: Oil having a natural tendency for holding a certain amount of water, the churning effect when it passes through the step-bearing pumps causes a more or less perfect mechanical mixture, thus producing the emulsion. A certain small percentage changes composition by chemical action. It is claimed that if the oil is allowed time for settlement, the emulsion, except for the small percentage changed chemically, will separate into oil and water. If the oil is not used more than 15 times in 24 hours and filtered with proper heating, no trouble should result. Where the oil is used more frequently under high pressure and in bearings where the circumferential speed of the shafts in the bearings may be as high as 2500 ft. per minute, it is best to use two sources of supply alternately.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Coal Consumption in High-Speed Engine Stations.

The coal consumption in the electric lighting plant of the Hobart Light & Power Company, of Hobart, Okla., averages about 10 lb. per kw-hour for each 24-hour run. During the heavy load portions of the day this is as low as 7 lb., and rises to 13 lb. on light load. The station has simple high-speed engines. The Montrose Electric Light & Power Company, of Montrose, Col., which has compound high-speed engines, requires from 8 lb. to 9 lb. per kw-hour. Twenty-four-hour service is given in this plant also. These figures are better than is common among high-speed engine central stations. Close records ar kept in these plants, both of which are controlled by the U. S. Light & Traction Company, of Denver.

Public Service in Aurora, Neb.

Aurora is a little city in Nebraska with a population of about 2500. It has a central-station company—the Aurora Electric Company—which is owned by 14 local business and professional men. This company has now asked the permission of the State authorities to issue additional stock in the sum of $28,000 for the improvement of the plant. The present capital is $32,000, all of which is represented in the property. The company now seeks to install a district heating system, and for this purpose as well as to provide funds for some electrical improvements, it seeks the increased capitalization. It is proposed to lay a 9-in. steam main from the power house around the court-house square, where most of the business buildings are placed. Exhaust steam will be utilized, and the pipe line will be about 2600 ft. long.

Both the stockholders of the Aurora company and the local authorities are proud of the pleasant relations which have always obtained between the company and the city. The company pays taxes on the amount of its capital stock and indebtedness and also on the franchise valuation without protest. Last spring the company volunteered to enter a profit-sharing agreement with the city. This offer was accepted. The stockholders of the company are allowed a dividend of 10 per cent and the city has a share of all net receipts above that amount. For the past three years the net income to stockholders has been from 10 to 12 per cent, and with the additional equipment it is thought that the profits to the city will be of appreciable amount.

Analysis of Discontinuances of Electric Service.

When notifications of discontinuances, or "cutoffs," as they are termed, are received by the Commonwealth Edison Company, of Chicago, the cause is carefully investigated and what is known as a "cutoff report" is made up from the data obtained in this way. Cutoffs are ascribed to seven causes:

(1) Out of business (no successor) or vacated premises.

(2) Seasonable business—that is, such as in its nature might be expected to be temporary.

(3) Change to other electrical service.

(4) Dissatisfaction with bills or service.

(5) Lost to competition.

(6) Moving; business secured in new location.

(7) Non-payment of bills.

Taking October, 1909, as a typical month, it is found that the total number of cutoffs reported is 19,665. Referring to the preceding numbers attached to the various causes of discontinuance, the total number of cutoffs is divided as follows: (1), 8083; (2), 3597; (3), 2643; (4), 701; (5), 221; (6), 3023; (7), 1397; total, 19,665.

It is interesting to note the small number of cutoffs due to causes (4) and (5) respectively, "dissatisfaction with bills or service" and "lost to competition." Nearly half of the cutoffs are due to customers going out of business without leaving a successor, or to vacated premises. By analyzing the cutoffs in this way, the company is enabled to keep very closely in touch with the requirements of its customers.

Cost of Railway Power in Chicago.

As the low cost at which the Commonwealth Edison Company of Chicago sells power to the traction companies of Chicago has been frequently commented upon, the following figures on the actual net cost per kw-hour to the railways will be of interest. Under the contract made between the Commonwealth Edison Company and the Chicago City Railway Company in 1908, the railway is to pay $15 per kilowatt of maximum demand per year plus a charge for energy consumed at the rate of 0.4 cent per kw-hour after Jan. 1, 1911. The maximum demand is determined according to rather elaborate rules, by taking into consideration a number of the maximum hourly outputs in kw-hours. The net kw-hour rate which is paid under such a contract, of course, depends entirely on the load factor of the railway load—that is, the ratio of the maximum to the average load.

The report of the Board of Supervising Engineers, Chicago Traction, for the year ending Jan. 31, 1908, recently issued, shows that the load factors for the Chicago surface roads vary somewhat, that of the largest system, the Chicago Railways Company, being 50 per cent, and 45 per cent for the Chicago City Railway. With a 50 per cent load factor for each kilowatt of maximum demand, there would be consumed 4380 kw-hours, which at 0.4 cent per kw-hour would amount to $17.52 per year. Adding $15 per kilowatt fixed or readiness-to-serve charge to this would make a total annual charge of $32.52 per kilowatt of maximum demand, which is equivalent to 0.75 cent per kw-hour. The energy is measured at the switchboards of the Commonwealth Edison Company's large steam turbine stations, where it is generated. The Commonwealth Edison Company furnishes the high-tension transmission lines from the generating stations to the various substations, which latter are owned and operated by the railway companies.

Testing Electric Meters.

In a paper presented at the recent annual convention of the Empire State Gas and Electric Association, Mr. C. G. Durfee, of Rochester, gave an account of the efforts of the New York Public Service Commission of the Second District, which has jurisdiction outside of Greater New York, to induce central stations to test their electric meters.

Early in 1908 the commission made recommendation to each of the 218 companies found without proper testing standards, indicating the type of instrument best adapted to the need of each company. This resulted in 167 of these companies equipping themselves with satisfactory standards, while 51 companies filed objections to incurring the expense. The records of the commission show that up to the present date 83 of the companies who have purchased standards have made practically no use of them; and that at the present time 223 companies in the Second District are satisfactorily equipped with testing

apparatus, 6 companies are partially equipped, 60 companies operating meters have no testing apparatus, 50 companies have filed objections to the purchase of apparatus, and 12 companies have made arrangements with outside companies to do their testing.

Several of the smaller companies purchased suitable standards merely because they felt obliged by law to do so, but felt that the expense was unnecessary and unwarranted. Several of these companies, however, after purchasing felt that as they had a certain amount of money invested in these standards, it would be well to make use of them and the results shown by tests made by these companies seem to prove beyond question that the purchase of the standards was really a paying investment. Reports filed with the Public Service Commission, Second District, show that some stations found from 30 to 77 per cent of their meters running slow. One station discovered that of its 318 meters, 242, or 76.1 per cent, were 4 per cent or more slow, and that only 14 meters, or 4.4 per cent, of the total number registered within 4 per cent.

Mr. Durfee referred to the case of a large plant, the management of which considered that an organization for meter testing would cost far more than would accrue from corrections of slow meters. The superintendent in order to determine the correctness of this view tested 1000 meters in service, and found that on the basis of the data thus obtained, the company was losing over $40,000 per year through meters unregistering. The result was that the company gave the superintendent full authority to organize an efficient meter-testing department.

Special Street-Lighting Installations in Chicago.

The practice of installing special systems of street light by business men in various localities of Chicago to draw trade, as previously mentioned in these columns, continues to expand at a satisfactory rate. On West Twenty-sixth Street, near Kedzie Avenue, the merchants have installed 62 street-lighting posts, and on Blue Island Avenue, between Sixteenth Street and Twenty-second Street, and also on Commercial Avenue, near Ninety-second Street (South Chicago), there are like installations. The Blue Island Avenue equipment consists of 51 posts and the South Chicago installation of 78. Each post is of iron of attractive design, and supports four 60-watt tungsten lamps in frosted globes. Electricity is furnished by the Commonwealth Edison Company through underground conductors.

In all, five localities in Chicago are now provided with business men's special advertising illumination of this character. The total number of posts installed is 274 for the four-light posts and 50 posts bearing five lights each. Each merchant taking this service pays $1.50 a week, and the lamps burn from dusk to 10 p. m. six nights a week, and from dusk to midnight on Saturday, under a two-year contract. The total income to the central-station company from this class of business is now $411 a week.

Mr. O. R. Hogue, of the Edison Company, gives special attention to this feature of the contract department's activities, and he has devised a demonstrating post of wood which is made in sections and is easily placed in an automobile and carried to any part of the city, where it can be set up, with lamps attached, to give possible customers an idea of what the illumination will be like on their own streets. Business men in several other localities are figuring on adopting this service, for when they see their neighbors on a near-by street drawing customers to their stores by the attractiveness of a brightly lighted and specially lighted thoroughfare, they feel a desire to emulate the example.

In West North Avenue, between Western and California Avenues, the Commonwealth Edison Company has installed and is operating a decorative-lighting installation of different character. Festoons of ordinary carbon 16-cp incandescent lamps are strung across the streets, and the merchants have erected ornamental columns at the curb-line, the whole effect being that of a holiday carnival, as the lighting is to be furnished from Nov. 24 to Jan. 1. The festoons, or stringers, consist of nine having 75 lights each and eight of 60 lights each. They are festooned from a point above the center of the roadway to the sidewalk line and at the central point in each stringer there is a red 32-cp lamp. In all there are 1155 lights in this carnival illumination.

Toronto Electric Sign.

The "new-business" department of the Toronto Electric Light Company has been fortunate in securing many sign contracts in Toronto, the most recent being for a large sign for the Hassan cigarette. The "Hassan" sign is 36 ft. in width, 32 ft. high, and contains 955 2-cp lamps. The top of the sign is 45 ft. above the roof and 110 ft. above the street. The frame contains 3000 ft. of 1-in. pipe. The letters in the word "Hassan" are 4 ft. in height, in "Cigarette," 30 in., and the smaller letters

ELECTRIC SIGN IN TORONTO.

are 2 ft. high. The lamps are frosted tip, the border amber, the leaves and scrolls green, the snakes ruby, the torch amber, and the flame ruby, amber, canary and clear. This sign is the largest in Canada, at the present time. The letters of the sign burn steadily; the border continually changes, the leaves, scroll and flame waving, and the snakes crawling upward. A large sign for the Ramsay Kodak Company has been installed on King Street, and many smaller signs have been placed in the lesser business districts of the city.

Increase in Chicago Central-Station Business Analyzed.

The year 1909 will be a banner year for the Commonwealth Edison Company, judging by the increase of business reported so far this year. Taking the calendar year up to Nov. 20, with six weeks remaining to complete the year, the total increase of business amounts to 910,943 16-cp equivalents. It is interesting to observe how this increase is divided, and the following figures are particularly instructive. It will be understood that in the following tabulation the first figure given refers to the connected load of Nov. 20, 1909, and the second figure to the corresponding total at the beginning of the year 1909.

Low-Tension Direct-Current System.

Incandescent lamps, 1,252,595—1,072,179, an increase of 180,416.

2000-cp arc lamps (575-watt), 9690—8463, an increase of 1227.

1200-cp arc lamps (350-watts), 1696—2634, a decrease of 938.

Battery charging in kilowatts, 6027.2—5116.9, an increase of 910.3.

Motors (General) in horse-power, 66,192.8—53,672.4, an increase of 12,520.4.

Motors (elevator) in horse-power, 39,848.1—33,635.3, an increase of 6212.8.

Alternating-Current System.

Incandescent lamps, 1,568,769—1,284,411, an increase of 284,358.

2000-cp arc lamps (450-watt), 5367—5456, a decrease of 79.

Battery charging in kilowatts, 1668—909.1, an increase of 758.9.

Motors (general) in horse-power, 39,494—27,984.1, an increase of 11,509.1.

Motors (elevator) in horse-power, 1670.6—1409.5, an increase of 261.1.

Series Arcs.

2000-cp arc lamps (575-watt), 1017—1005, an increase of 12.

1200-cp arc lamps (350-watt), 789-817, a decrease of 28.

Total Connected Load.

Reduced to 16-cp lamp equivalents, the total at the beginning of the year was 4,370,772, and at Nov. 20, 1909, 5,325,695, an increase of 910,943. As might be expected, the increasing use of the tungsten lamp and tungsten clusters has reduced the number of arc lamps of some classes in use. In every other class of business a gratifying increase is shown. There are about 8000 tungsten clusters in use. Perhaps the greatest ratio of increase is shown in the amount of alternating current used for battery charging through some form of rectifying apparatus. The figures are very interesting and show in a most convincing manner the varied activities and enterprises of this great central-station company. The growth of the business is marked. During September, as previously noted in the *Electrical World*, the number of contracts closed by the contract department of the company averaged 299 for every working day. In October the number of contracts closed averaged 311 for each of the 26 working days of the month. These contracts are all for new business, although "successors" are included, meaning where a new contract is made with a business successor of a former customer.

An Inexpensive Electric Equipment for Dumb-Waiters.

By S. H. Sharpsteen.

An electric dumb-waiter equipment of more than ordinary interest has been placed in service in the New York Infirmary for Women and Children, on account of the simplicity of the installation.

Fig. 1 shows the arrangement of the motor and gear as it would appear if looked upon from the top, *M* being the motor

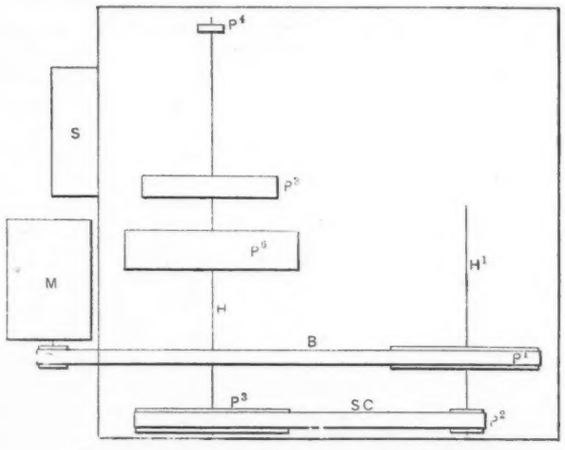


FIG. 1.—PLAN OF DUMB-WAITER INSTALLATION.

placed on a shelf fastened to the outside of the dumb-waiter shaft, *S* the automatic controller secured to the same support just above the motor, H^1 a small piece of shafting on which is fastened pulley P^1, driven by belt *B* from the motor pulley. On the same shaft is a small sprocket wheel P^2 which drives a sprocket chain *SC*, which in turn drives the large sprocket wheel P^3 on the main dumb-waiter shaft *H*.

The 1-hp motor *M* runs at 1400 r.p.m. and transmits power from the pulley *P* to pulley P^1 by means of a leather belt. Use is made of a chain belt for transmitting power from P^2 to P^3

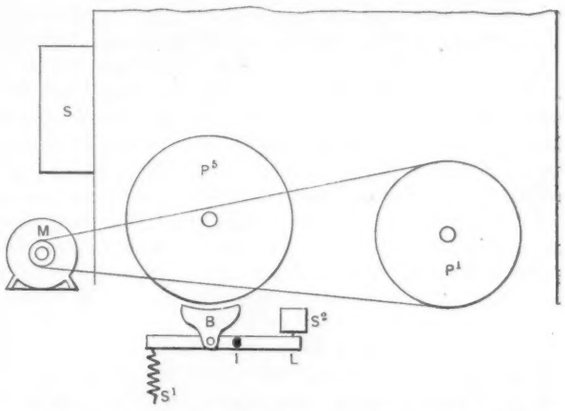


FIG. 2.—ELEVATION OF DUMB-WAITER INSTALLATION.

because the belt speed is too low for a leather belt. P^6 is a pulley 10 in. in diameter with a 4-in. face, to which the brake is applied. P^3 is the pulley over which runs a chain, one end of which is connected to the car and the other to the counterweight. P^4 is a small pulley carrying a leather belt to work an indicator that shows the position of the car at any time.

The shaft *H* is furnished with a hanger on each side of the brake pulley P^6 to keep it from springing when the brake is applied. For the same reason this shaft is heavier than is necessary to transmit the required power. Fig. 2 is a side view showing the brake pulley P^5 with the brake shoe *B* located under it.

The simplicity of the braking devices is the most novel feature of the installation. They were purchased from a motor manufacturing company for $25 each. The brake lever *L* is pivoted at *I* and is held up by the spring S^1, which forces the brake shoe *B* against the pulley P^5 when the circuit is opened and it is desired to have the car at rest. When the starting button is pushed and the main circuit is closed, current passes through the solenoid S^2, which pulls up on the lever *L*, thereby allowing the brake shoe *B* to fall away from the pulley P^5 and permitting it to turn.

The use of solid iron pulleys, well fastened to their respective shafts, is desirable for this service because the strain on the pulleys is more severe than the mere transmission of power required to operate the loaded car. The sudden stopping and the power going on before the brake is off, which is necessary to keep the car from dropping slightly before it starts, tend to loosen the pulleys if they are not securely fastened.

The brake casting with the wooden shoe *B* is pivoted on the lever *L* so that it can adjust itself to the face of the pulley P^5; the contact face of the shoe is lined with leather, which holds better than any other material.

For an indicator to show the location of the car use is made of a common speed indicator, the shaft being lengthened out, as

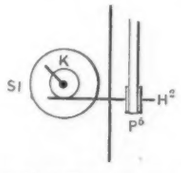


FIG. 3.—ARRANGEMENT OF INDICATOR.

shown at H^2, in Fig. 3, so that it extends into the waiter shaft and holds the pulley P^6, which is belted to the pulley P^4 in Fig. 1. On the slow-turning shaft of the speed indicator is mounted a pointer *K*, and over the working part of the speed indicator is placed a steam-gage case. The indicators are placed

where they can be easily seen in the kitchen on the sixth floor, from which the dumb-waiters are operated.

The controlling buttons for each of the two cars in use are located side by side in a vertical row; when the top one is pushed the car moves upward, and when the bottom one is pushed the car moves downward, and when the middle one is pushed the car is brought to rest.

When it is desired to send a tray of dishes to a certain floor it is placed on a car, the door shutting the shaft from the kitchen is closed by a vertical movement and the proper button is pushed; when the pointer indicates that the desired floor is reached a second button is pushed and the car comes to rest.

The dumb-waiter doors lift and as they pass upward they open a simple, inexpensive switch which is placed in the motor line to prevent the motor from being started until the door at which the car stands is closed. As the car moves up or down from any one of the doors they are automatically locked so that employees cannot possibly get hurt by the car coming down on them.

The starter is a standard device with four solenoids, one for lift, one for reverse and two smaller ones for varying the resistance in the armature circuit. The simple and cheap braking device holds so well that when a man rides on top of the car the equipment operates in the usual manner. Standard knock-out switches are placed at the bottom and the top of each dumb-waiter shaft to open the circuit and stop the cars in case of necessity.

The arrangement described above was devised by Mr. F. B. Easton, chief engineer of the building, under whose direction the equipment was installed.

A Bachelor's Electric Service.

The Waverly Company, Indianapolis, has had much success in securing newspaper publication of the following clever paragraphs, entitled "Diary of an Up-to-Date Man":

"Some people think it costs a lot of money to be thoroughly well groomed and up to date, but Charles Pinkham Jones—everybody knows 'Pinky' Jones, the 'pink of perfection' his lady friends call him—Mr. Jones, as we were saying, keeps a diary that includes an expense account, with a glimpse of which your correspondent was favored the other day, and from it he is able to give exact figures as to what it costs a bachelor, who uses modern labor-saving appliances instead of a valet, to present himself every morning at the bank, the perfect pattern of a well-groomed man. Here is the record for an average morning:

	Electric current Kw-Hours
Rose at seven and took an electric bath, for which the current used was	.3333
Heated bedroom for ½-hour with electric stove	.5000
Heated water for shaving on electric stove	.0333
Used electric boot cleaner	.0133
Pressed trousers with electric iron	.0400
Ironed silk hat with electric ironer	.0333
Kneaded dough for a loaf of bread with electric kneader	.0066
Boiled a pint of coffee on electric stove	.0666
Cooked a chop by electricity	.0666
Aired my room with electric fan	.0238
Turned on electric piano while I ate my breakfast	.0500
Cleaned the knives and forks with electric cleaner	.0010
Polished the plates with electric polisher	.0050
Curled my moustache with electric curling iron	.0025
Lighted a cigar with electric lighter	.0003
Rode in electric elevator to the basement	.0033
Drove my Waverly electric 4½ miles to the bank	1.0000
Total kilowatt-hours	2.1789

for which I pay 10 cents per hour or 22 cents in all. This does not take account of the current used in my electric clock, but as a single kw-hour will keep that running for 10 years it seems safe to disregard the clock.

"After this who will question the economy of electric power? For the information of any reader who does not understand the term we will add that the kw-hour is the unit of measuring electric current charged for by the lighting company. It means the use of a thousand watts of electricity, or the equivalent of 1⅓ hp for one hour."

INTERIOR WIRING AND ILLUMINATION

Davenport (Iowa) Street Illumination.

Davenport, Ia., is one of the many cities striving to secure better street lighting at the present time. An association of merchants doing business on Brady Street has been formed, and one result of its efforts is a special system of street illumination on Brady Street, from Second to Fifth Streets. In these three blocks there are 48 ornamental iron posts, 16 in each block, each post supporting five tungsten lamps. One 60-watt tungsten surmounts the post, and four are suspended from brackets near the top. All are enclosed in spherical frosted globes. The installation of this special street lighting was marked by a celebration, with a parade, speeches and band music.

Factory Lighting.

Mr. L. B. Marks delivered an address, Nov. 17, on "Factory Lighting," in Washington, D. C., at a joint meeting of the Washington Society of Engineers and the Washington Section of the American Institute of Electrical Engineers. This address contained the substance of Mr. Marks' recent paper on "Factory Lighting" read at the I. E. S. convention, and in addition a discussion of the application for factory lighting of open, enclosed and flaming-arc lamps, Cooper Hewitt mercury arcs, Moore tubes (both yellow and white light), tungsten lamps, etc. The system of indirect lighting by reflection from the ceilings and walls was also discussed. Among the points brought out in the address were that in the average factory (lighted by local lamps) the intensity of artificial light on the work is usually two or three times and often 10 times that of the daylight illumination which is sufficient and satisfactory for the work; and that in the average factory, the glare (due to faulty lighting design) is excessive and accounts in a large measure for the impossibility of properly performing some of the work at night. The outlines were given of a design of a factory lighting installation (using tungsten lamps) in which the glare is reduced to a minimum and the diffusion of light on the machines approximates closely that obtained in daylight.

Street Lighting Versus Policemen.

Grand Rapids has made another notable increase to the span-wire arch system of lighting its business streets. West Leonard Street celebrated the lighting of a mile of that thoroughfare on the evening of Nov. 19. This is the longest single section of street which has yet adopted the system of lighting which is becoming almost universal over the business streets of Grand Rapids. Probably no other city of the size of Grand Rapids in the country has so many miles of specially lighted business streets. In the speeches made during the jollification, Mayor Geo. E. Ellis said: "If you have a place that is of shady reputation, put a light at the front door and another at the back, and that place will become good." The Grand Rapids *Daily News*, in commenting on this, says: "Doing away with dark corners, dark streets and dark places generally means much for the moral condition of a city. The criminals and evil-minded are the ones who do not like too much light. While light will not entirely do away with this undesirable class, it will drive it farther and farther away, until eventually there will be no place left for it." The *News* then favors the extension of the lighting system by the city into some of the streets of shady reputation as a plan of getting rid of their undesirable tenants. It says: "A few extra lamps would not be as expensive as one policeman, and in some cases would prove more efficacious."

Street Illumination.

A lecture on "Street Illumination" was given by Mr. J. R. Cravath, of Chicago, before the Engineers' Society of Milwaukee Nov. 10. He first pointed out the great advances that have been made in electric street illumination the past five years. For many years gas-mantle burners have played a very important part in the economical lighting of the residence streets of the larger cities. The recent improvements in electric lighting, however, have so reduced this cost that it is now cheaper than gas and more desirable in other ways. In the electric street-lighting field changes are going on so rapidly that the situation is almost confusing to those actively engaged in this work. Within three years tungsten street lamps have come into use which give 2½ to 3 times more light for a given consumption that the older incandescent lamps, and are much more efficient than the common enclosed-carbon arc.

He reviewed briefly the history of arc lighting in the past few years, and showed how the magnetite luminous arc, requiring direct current, came to displace the alternating-current enclosed-arc lamps, involving not only a change in lamps, but radical changes in all of the arc-lamp transformers and apparatus. On top of this comes the titanium-carbide arc, involving still different apparatus, as it is suited for operation on 60-cycle alternating-current circuits. The annoying thing about these changes, from the standpoint of the company or of the municipality owning and operating a street-lighting plant, is that none of these new arc lamps can be used interchangeably on the transformers and circuits employed for the preceding best type. He showed by lantern slides the great increase in efficiency of arc and incandescent lamps in a period of five years. He also showed types of ornamental posts which have been installed for lighting the business streets of various enterprising cities.

Regarding the use of arc versus tungsten lamps, he stated that in the outlying districts of large cities where enclosed-arc lamps are placed at every other corner, conditions can be most decidedly improved by the use of 80-cp tungsten lamps on each street intersection. In larger cities, where there is a greater density of population and consequently more money available for street-lighting purposes, the question is not so easy to decide whether it is best to adopt large arc lamps on each street intersection or smaller incandescent lamps spaced more frequently.

One can easily figure from the candle-power of the arc and tungsten lamps offered that more illumination can be given at the darkest points midway between lamps by the use of some of the modern efficient arc lamps at each street intersection than by expending a similar amount of money on the smaller incandescent units at more frequent intervals. In all street-lighting work it is the point of minimum illumination—that is, the darkest point, half way between lamps—which should always receive first consideration. The illumination of the rest of the space usually takes care of itself. As a general proposition, it is not desirable to have the lamp deliver too much light immediately in the vicinity of the lamp, because it produces too great a contrast and makes the dark spaces appear even darker. In general, a much larger total volume of light can be had from the modern arc lamps than from the modern incandescent lamps for a given expenditure of electrical energy. Furthermore, with the present street-lighting devices, an arc lamp hung at street intersections is useful for lighting in four directions, whereas a lamp hung between street intersections is useful for lighting in only two directions. This fact tends in itself to run up the cost of lighting per mile of streets as soon as either small or large units can be introduced between street intersections.

It is easy to figure numerically that more light can be delivered midway between lamps by the use of small lamps scattered along the street, but here the physiology of the human eye intervenes and raises a question. It is obvious that the object of street lighting is to enable one to see along the street. One cannot see as well when facing a few large lamps of high candle-power as when facing a larger number of lower candle-power lamps. It is well known that bright lamps within the range of vision, when there is but little surrounding light, have the effect of greatly reducing the ability to see clearly. Just what bearing this has on the street-illumination problem as regards the use of large arcs at street intersections versus small units, the speaker confessed he did not know, and did not think the matter had ever been properly and scientifically investigated. In the light of present knowledge of lamps, illuminating engineering and physiology, it would not be an extremely expensive matter for any city contemplating a new system of street lighting to conduct some practical experiments under the direction of competent experts, which should settle some of these points.

Mr. Cravath said the electric lighting of streets can usually best be accomplished in connection with the other electric light and power business of the city. The power plant and distribution system required for the supply of electric light and power to the modern city is so large that street lighting represents but a small percentage of this business. It, therefore, is evident that street lighting should be more economically done by the companies having electric light and power business on a large scale than by a company or municipality engaged in street lighting. The existence of two or three electric light and power distributing systems in a city, each with its separate set of conduits, poles and wires, is not only an economic absurdity, but a nuisance. The logical way to handle these matters is by well-regulated monopoly rather than by competition. He congratulated the State of Wisconsin on having established a commission for the regulation of these matters. The controversies which have arisen between cities and electric light companies have sometimes been due to unfair prices or poor service. In other cases they have been the result of the dissemination of misinformation regarding the true costs of electric street lighting. The actual cost of street lighting in Massachusetts in both public and private plants can easily be determined from the report of the Massachusetts Gas and Electric Light Commission. Taking an example nearer home, he cited the example of Chicago, where the cost from 1903 to 1907 was given in the report of Messrs. Arnold and Young to the Mayor as $81.46 per lamp per year, which cost in 1908, when the report was made, was being reduced to $60.56 per lamp. The committee appointed by the Civic League of St. Louis estimated the cost per arc lamp if purchased by a municipal plant in St. Louis would be $69 per lamp per year.

In closing, he made a strong plea for a higher standard of illumination than is now common, and urged that whatever changes are made should be in the direction of higher standards of illumination rather than in a reduction of cost and the maintenance of existing inadequate lighting.

LETTER TO THE EDITOR.

Central-Station Boilers.

To the Editor of Electrical World:

SIR:—Referring to the communication in your issue of Nov. 4, entitled "Economical Methods of Meeting the Maximum and Minimum Demand for Steam," it is not quite clear whether the method therein proposed is to apply to an overload of short duration or to a sustained overload on a plant. In the case of the former one would hardly think of pressing into service one of the reserve boilers. The method proposed by Mr. Williams also presupposes that the fireman will know at just what moment the overload will come on and will have the boilers full of water and everything in readiness to meet the excess demand. While in a general way it is known at about what time the regular maximum peak load will commence, still in every power plant there are always overloads which come on without warning and they may be of long or of short duration. For these it is, of course, impossible to have everything in readiness as suggested by the article.

Then, again, the method of filling up the boilers to the limit

will not meet with favor with the majority of operating engineers; for when a boiler is being forced to take care of an overload, priming will surely result if it is as full of water as it will stand. We do not need to mention the disadvantages of this carrying over of water into either reciprocating engines or turbines.

Our power-plant practice has demonstrated that one of the greatest aids in meeting sudden overloads is a fuel economizer. As ordinarily designed, an economizer usually contains about 30 lb. of water for each boiler horse-power. This is equivalent to at least a one-hour supply of feed water. As the temperature of the water in the economizer is very nearly equal to the temperature of the water in the boiler, there is, therefore, no danger of lowering the boiler pressure or of producing undue strains by feeding the boiler continuously with as much water as may be required. I believe this is a much more satisfactory method of preparing for an overload than that of filling the boiler up and "letting her run."

An economizer, also, has the advantage that this supply of hot water is always on hand, and the attendant does not have to know when a sudden overload is coming. It also has the further advantage that, as the boilers are being forced and the temperature of the escaping gases is considerably in excess of normal condition, the temperature head between the water entering the economizer and the exhaust gases is increased, and consequently a larger flow of heat into the water will ensue.

Thus, while we mentioned that the economizer had enough hot water on hand to supply the boilers for one hour, it will be seen that, due to the higher rate of absorption of heat, the boilers can be fed with water at very nearly the steam temperature for a much longer period. These considerations are well borne out in practice. It might be said that the economizer is to the steam generator what a storage battery is to the electric generator, or the flywheel to the engine.

NEW YORK. G. F. FENNO.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Determining the Flux in Air-Gaps.—R. RUEDENBERG.—Various experimenters have recently endeavored to determine the exact distribution of the magnetic lines of flux in the air-gaps of dynamos by means of testing coils. The author points out that these methods give only approximate values, because the testing coils must have certain dimensions and therefore give only the mean of the fluxes within the space covered. The author shows how to apply a correction to change the curve which is experimentally plotted into a curve which represents more correctly the exact distribution of the flux.—*Elek. und Masch.* (Vienna), Nov. 7.

Compensating Speed Variation of Shunt Motors.—A note on a recent British patent (22,159, 1908; Nov. 4, 1909) of W. Stansfield and J. J. Hatt. To obviate the rise in speed of shunt motors due to the heating of the field coils, two opposing field windings are employed. The weaker is connected directly across the supply mains, and the stronger is placed in series with a resistor having a negligible temperature-resistance coefficient. As an alternative, the weaker winding may be connected in parallel with the resistor. The difference between the ampere-turns of the two windings remains constant for all temperatures.—Lond. *Elec. Eng'ing*, Nov. 11.

Mercury-Vapor Rectifier.—M. LEBLANC, JR.—The first part of an illustrated article in which the author discusses the Cooper Hewitt mercury-vapor rectifier. The object is to explain in detail the part which each of the elements plays in the apparatus and to show how these different elements must be calculated in order to assure a good operation of the converter. The article is to be continued.—*La Lumière Elec.*, Nov. 6.

Lamps and Lighting.

Flame-Arc Lamps.—P. HEYCK.—The conclusion of his paper read before the Dresden Electrical Society, the first part of which has been abstracted in the Digest. If inductance coils are used instead of series resistors for alternating-lamps, the waste of energy is reduced. This is the case both with arc lamps with pure carbon electrodes and with flame-arc lamps. With flame-arc lamps the use of inductance coils has, however, still another effect, since it increases the candle-power of the lamp. Both effects result in a very considerable reduction of the specific power consumption. The explanation is given by the oscillograph curves in Figs. 1 and 2. Fig. 1 gives the curves for the Excello lamp, operated with a series resistor. Fig. 2 gives the curves with an inductance coil. Curve *a* is the voltage of the network, curve *b* is the voltage of the terminals of the lamp, curve *c* the current. The curve of the voltage of the network is almost sinusoidal. With a series resistor the curve of the current is in time-phase with the voltage, but distorted. This distortion is a characteristic feature of the flame-arc lamps. The voltage must have risen to a certain definite value before the current begins to pass. In Fig. 2 the voltage of the network is advanced in time-phase before the current. For this reason at the moment when the current curve passes through zero, the voltage is already sufficient to let current pass through the lamp. The current, therefore, rises

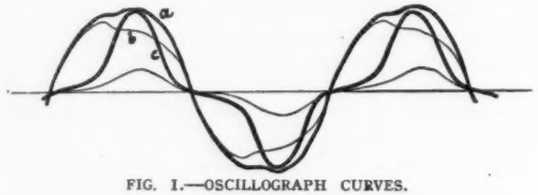


FIG. 1.—OSCILLOGRAPH CURVES.

more rapidly than in Fig. 1. The light period in comparison with the dark period during each full period is lengthened and, therefore, the candle-power is increased. The power factor of the circuit, which was 0.83 with the series resistor, becomes 0.68 with the inductance coil and the candle-power increases from 1620 to 2100 mean hemispherical hefner candles. The specific power consumption decreases from 0.28 watt to 0.18 watt per mean hemispherical candle-power. Another recent improvement in flame-arc lamps is the introduction of lamps with electrodes one above the other. This advance has become possible by the introduction of special "T. B." electrodes, which consist of a thick strongly impregnated core surrounded by a relatively thin cylinder of pure carbon. The "axis lamp"

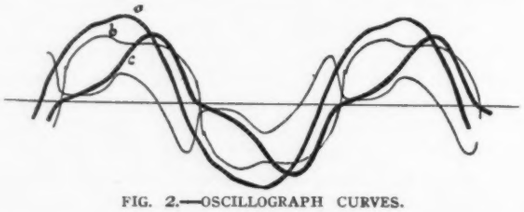


FIG. 2.—OSCILLOGRAPH CURVES.

is of this type, for use both with direct current or alternating current. With direct current either three lamps are connected in series in a 110-volt circuit (the lamp voltage being 30) or two lamps in series in a 110-volt circuit (the lamp voltage being 40). The candle-power of these lamps with direct current is from 1200 to 3900 mean hemispherical hefner candles, with a specific consumption of from 0.24 watt to 0.21 watt per hefner. In alternating-current circuits three lamps are used

in series in a 110-volt circuit with 28 volts at the terminals of each lamp. The distribution of light from different arc lamps is given in Fig. 3. The curves refer to the following lamps:

1	Excello,	10	amp.,	110/2	volt,	550	watt,	2550	cp,	dioptric yellow
2	"	"	"	"	"	"	"	1910	"	" white
3	"	"	"	"	"	"	"	2500	"	" yellow
4	"	"	"	"	"	"	"	1870	"	" white
5	Axis,	15	amp.	110/3	volt,	550	watt,	2150	cp,	white
6	"	10	amp.	110/2	volt,	550	watt,	2050	cp,	white
7	Quartz	lamp,	2.5	amp,	220	volt,	550	watt,	1250	cp.

Finally tables are given stating the total cost of operating different lamps with direct current or alternating current, in-

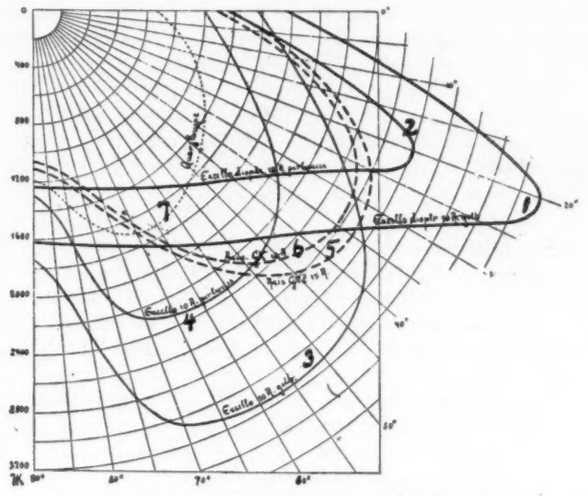


FIG. 3.—PHOTOMETRIC CURVES OF VARIOUS LAMPS.

cluding the cost of energy, electrodes, globes and attendance. The results are given as follows for direct current, the cost being given in cents for 1000 hefner candle-hours:

Excello yellow		Excello white		Axis, three in series.		Axis, two in series.	
1100 cp	3150 cp	825 cp	2350 cp	980 cp	2150 cp	1550 cp	3140 cp
Cost of 1000 hefner-hours, in cents:							
2.225	1.375	3.025	1.875	2.65	1.975	2.2	1.825

For alternating-current lamps the figures in cents per 1000 are given in the following table:

	Excello yellow	Excello white	Axis
With series resistance	1680 cp 2.175 cts.	1250 cp 3.025 cts.	1200 cp 3.225 cts.
With inductance coil	2150 cp 1.475 cts.	1550 cp 2.125 cts.	1400 cp 2.425 cts.

In this comparison the cost of the kw-hour is assumed to be 5 cents; of course, the lower the price of energy the more important becomes the price of the electrodes. This is higher for the Axis lamps than for the Excello lamp, so that the latter seems to be, in general, superior to the former.—*Elek. Zeit.*, Nov. 11.

Metallic-Filament Lamps.—B. DUSCHNITZ.—The conclusion of his review of the latest methods of making metallic filaments. In the present instalment the author describes methods in which the metallic filament is made of carbon-free metal without using any wet process. Of the metallic filaments so far on the market only tantalum can be worked that way, as it is ductile. For tungsten it is recommended to stamp a powder of tungsten metal tightly into a tube of ductile metal and then treat the whole by drawing or rolling. Finally the cover which is not tungsten is removed either chemically or mechanically. It has been found later that it is better to begin with tungsten sponge rather than with tungsten dust. Such tungsten sponge may be made, for instance, by preparing a tungsten alloy and removing the other metal from the alloy by means of a solvent which does not attack the tungsten. Thorium filaments have also been made in this manner. Various other processes of the same general type are described.—*Elek. Anz.*, Nov. 4.

Artificial Illumination.—L. GASTER.—A continuation of his illustrated lecture on modern methods of artificial illumination. The author concludes his description of gas lamps and passes over to acetylene.—Lond. *Electrician*, Nov. 12.

Linear Sources of Light.—E. W. WEINBEER.—An article illustrated by diagrams on photometric measurements of linear sources of light, such as mercury-vapor lamps.—*Zeit. fur Beleucht.*, Oct. 10.

Generation, Transmission and Distribution.

Steam Turbine.—An illustrated description of the steam turbine of the Oerlikon Company. This turbine is of the pure action type, with several pressure stages in a single casing. It is distinguished from other action turbines by the fact that in it use is made of the speed of exit of the steam from the revolving disks as well as of the inlet speed. For this purpose the turbine consists of one or more groups of pressure stages, each having an inlet of constant length, while the successive expansions of the steam are allowed for by increasing the radial length of blade from stage to stage within each group. Once the maximum practical length of the blade has been attained the steam passes to a second group of stages, distinguished from the previous group by an increased inlet arc. This increased arc again remains constant throughout the various stages of the new group. The radial length of blade diminishes in general from the last stage of one group to the first stage of the next, and then increases again gradually from stage to stage. In this way, the turbine makes use in each stage of the exit speed of the steam from the previous stage, except in the case of the last stage of each group.—Lond. *Elec. Review*, Nov. 12.

Rolling-Mill Motors.—W. MANKTELOW.—An illustrated article on the design and operation of rolling-mill motors and their accessories. The author deals with electrical versus steam driving, the energy and horse-power required, power for auxiliaries, types of motor used, gearing and time of reversal, use of flywheel and design of batteries as load equalizers. The author thinks that in general electro-mechanical is preferable to electro-chemical storage.—Lond. *Elec. Review*, Nov. 5.

Destructor Plant.—An illustrated description of the generating plant connected with the destructor plant in a suburb of Melbourne. Electrical energy is furnished to the municipal supply company. In order to avoid the troubles of synchronizing, an induction generator is employed. It has a rating of 125 kw.—Lond. *Elec. Review*, Nov. 5.

Traction.

Single-Phase Traction in Hamburg.—FREUND AND CRONBACH—The conclusion of the illustrated description of the single-phase system used on the city and suburban railway from Blankenese to Ohlsdorf. In the present instalment the operation and maintenance of the motor-cars is described and the results of tests are given. The mean weight of the car, including passengers, is 74.8 tons. The consumption of energy is 33.6 watt-hours per ton-kilometer. The longest runs on Sundays are 480 km (290 miles), on other days, 410 km (246 miles), while the mean run on Sundays is 330 km (198 miles) and on other days 300 km (180 miles). The part of the motors which gets heated to the highest temperature is the commutator. The rise of temperature was found to vary between 66 deg. and 53 deg. The final temperature was reached after three or four hours of operation. Speed curves and energy-consumption curves of typical runs are given.—*Elek. Zeit.*, Nov. 11.

Single-Phase Railway.—The conclusion of the illustrated description of the single-phase railway between Rotterdam, The Hague and Scheveningen. Each of the motor cars is provided with two 180-hp compensating-series motors.—Lond. *Electrician*, Nov. 12.

Installations, Systems and Appliances.

Statistics of German Central Stations.—E. SCHIFF.—A review of the statistics of the German Association of Central Stations for 1908. The statistics refer to 320 stations and therefore covers only a small part of all the stations. However, it contains many data of interest. Some of these are summed up in three tables. The capital invested varies between $78 and $619 per kilowatt, the average income per kw-hour between 1.46 and 16.55 cents, the total expenses per kw-hour between 0.36 cent and 11.71 cents, the cost of fuel per kw-hour between 0.10 cent and 3.46 cents. The effect of the introduction of metallic-filament lamps is not directly evident

from the statistics. Nevertheless, all the stations with one exception show an increased income.—*Elek. Zeit.*, Nov. 11.

Electric Industries in England.—R. K. Morcom.—A lecture on the present state of "heavy electrical engineering" in England. Fig. 4 gives curves which show the drop in price of moderate-size generators in comparison with the variation and general rise of the price of copper and pig iron. Curve 1 refers to copper and curve 2 refers to pig iron, while curve 3

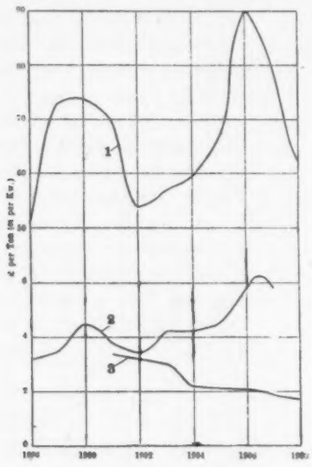


FIG. 4.—COST CURVES.

gives the price of moderate-size generators per kilowatt. Dealing with the distribution of capital in the industry a table of the capitalization of various branches of the electrical industry and a brief review of the developments of the industry are given.—Lond. *Elec. Eng'ing*, Nov. 11.

Buenos Ayres.—An illustrated description of the new power plant at Buenos Ayres. When complete, this station will contain 10 7500-kw turbo-alternator sets, and in addition several smaller sets. The first instalment of this equipment, consisting of five 7500-kw turbo-alternators and two 1000-kw turbo-dynamos, is now being erected.—Lond. *Elec. Review*, Nov. 12.

High-Tension Switchgear.—A. G. Collis.—An abstract of a lecture in which the author advocated ironclad gear for most purposes, and remote solenoid control for heavy feeder boards; he emphasized the necessity of complete provision for isolation, and described up-to-date forms of oil switches, instruments and relays discussing the most suitable arrangement of connections for the latter.—Lond. *Elec. Eng'ing*, Nov. 11.

Tariff for Selling Energy.—A. Vietze.—An article in which the author suggests a new tariff for charging for electrical

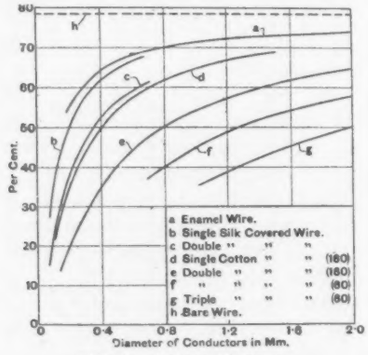

Per Cent.
Diameter of Conductors in Mm.
a Enamel Wire.
b Single Silk Covered Wire.
c Double " " "
d Single Cotton " " (180)
e Double " " " (180)
f " " " " (80)
g Triple " " " (80)
h Bare Wire.

FIG. 5.—SPACE FACTORS.

energy, specially adapted for the needs of co-operative central stations supplying energy over an extended agricultural district. —*Elek. Zeit.*, Nov. 11.

Wires, Wiring and Conduits.

Enameled Wire.—C. F. Upward.—An illustrated article on the properties of enameled wire, the insulating material being similar to ordinary enamel, but of a high flexibility. Fig. 5 gives a series of curves showing the space-factors for enameled wire, single and double, silk-covered wire, also single and double cotton-covered wire, cotton Nos. 20, 160 and 200 being used for the latter. It will be seen that enameled wire up to a diameter of approximately 0.6 mm has a better space-factor than even single silk-covered wire, and that it is considerably higher than all cotton-covered wires, including those insulated with the finest cotton, No. 200. Owing to the methods of manufacture employed, the wire is capable of withstanding very high temperatures, and coils wound with enameled wire may be safely used up to temperatures of 150 deg. C. continuously, or 200 deg. C. temporarily. It is not possible to state the value of the maximum current which is permissible without the given temperatures being exceeded, as the temperature of the coils will be largely dependent upon the cooling conditions prevailing. According to tests carried out, however, it has been found that under normal conditions, with the coils loaded continuously, the watt consumption (continuous current) must be equal to two-thirds of the product of the height h of the coil (in centimeters) and its diameter d (also in centimeters) or $w = 2/3\,hd$. The layer of insulating material is from 0.01 mm to 0.03 mm thick, according to the diameter of the wire. The insulation e.m.f. of single wires in contact with mercury is from 2000 volts to 2500 volts, or with water from 800 volts to 1000 volts after 25 hours' immersion. Enamel insulation is entirely non-hygroscopic.—Lond. *Elec. Eng'ing*, Nov. 11.

Insulation of Windings.—A note on a recent British patent (19,263, 1908; Nov. 4, 1909) of A. J. Boult (Felten & Guilleaume-Lahmeyerwerke Akt-Ges.). Transformer coils and armature windings comprising bare copper wires or bars separated by small strips of insulating material are dipped into a bath of rubber solution, or of acetyl cellulose. The armature or coil is then subjected to a vulcanizing treatment to harden the insulating mass.—Lond. *Elec. Eng'ing*, Nov. 11.

Electrophysics and Magnetism.

Vector Representation of Non-Harmonic Alternating Currents.—B. Arakawa.—A mathematical paper investigating in greater detail a method formerly proposed by Bedell and Tuttle. The chief results are as follows: The relative phase positions of two non-harmonic alternating quantities can be expressed by the term "equivalent phase difference," which is equal to the phase difference between two equivalent sinusoidal alternating quantities that give the same value of mean product of instantaneous values as the chosen non-harmonic alternating quantities. Any non-harmonic alternating quantities can be represented by radius-vectors, if their relative phase positions are expressed by equivalent phase differences between each pair. Generally, a vector diagram in n dimensions is required to show n independent non-harmonic alternating quantities simultaneously; but in special cases they can be shown in a figure of less dimensions. Summation or subtraction of any number of non-harmonic alternating currents can be performed graphically by representing them by radius-vectors and combining first two of them in a plane diagram and combining their resultant with a third, etc.—*Phys. Review*, November.

Gases Absorbed by Anode.—V. L. Chrisler.—An account of an experimental investigation of the absorption of gases by the anode in a luminous current. The results show that hydrogen is absorbed by sodium, potassium, a sodium-potassium alloy and mercury when used as anode in a luminous current, at such a rate as to indicate that with each atom absorbed is associated a negative charge of the same magnitude as the positive carried by it in solutions. The same has also been shown with nitrogen, using sodium, potassium, and a sodium-potassium alloy as anode; and in two cases, with helium, using sodium and mercury as anodes. The fact that nitrogen carries the same charge as hydrogen is consistent with the chemical valence of nitrogen, being in some cases unity. Rutherford has concluded from his experiments that the α article from radium is a helium atom carrying a positive charge of twice the magnitude of that carried by a hydrogen atom in solution, while the results given here indicate, on the other hand, that

with the helium atom is associated a negative charge of the same magnitude as that carried by hydrogen.—*Phys. Review,* November.

Ions Emitted by Hot Bodies.—O. W. RICHARDSON.—A second paper on the kinetic energy of the ions emitted by hot bodies. The chief result of the present investigation is represented in a diagram which exhibits a very close agreement between the distribution of the electrons from a hot platinum strip, in the absence of an external electric field, as found experimentally and that which was predicted in the former paper of the author on the hypothesis that the electrons emitted from the strip left it with a distribution of velocity equipalent to that required by Maxwell's law. The same issue contains a mathematical note of the same author on the kinetic theory of matter.—*Phil. Magazine,* November.

Induction.—P. GIRAULT.—A theoretical note on a law of the variation of induction along the air-gap of dynamos, with reference to a recent paper of W. Crudeli.—*L'Industrie Elec.,* Oct. 25.

Units, Measurements and Instruments.

Frequency Meter and Comparison of Alternating and Direct Current.—C. E. HIATT.—A description of a new frequency meter which depends for its action on the rate at which the heat is generated by the cyclic reversals of magnetic flux in a few milligrams of iron, say, when placed in a solenoid carrying the current whose frequency is to be determined. A fine iron wire, a few millimeters in length, was soldered to a

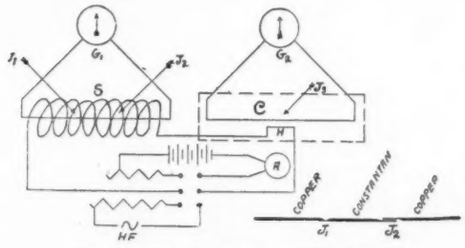


FIG. 6.—DIAGRAM OF ARRANGEMENT.

copper-constantan junction electrically opposed to a similar one, thermally and electrically equivalent, but not containing iron. This is shown in the heavy line detail drawing of Fig. 6. The junction J_2 contains iron, while J_1 does not. This equivalence can be obtained by repeated trials, after which both junctions are placed in a solenoid carrying a constant alternating current. A variation in the frequency of this current causes a proportional variation in the temperature of the junction containing the iron, thus producing a thermo e.m.f. readily observed by a galvanometer. The use of the differential thermo-junction does away with the necessity of excessive shielding and eliminates the troubles which might arise from Joulean heat generated in the coil. Rapidity of action is secured by making the heat capacity of the junctions small and their radiating power high. The alternating current through the solenoid was kept at a constant and known value by means of the regulating resistance and frequent comparison with a standard direct current as measured by the Weston ammeter *A*. This was accomplished with the help of the comparator *C*, shown enclosed by the hatched line rectangle in the illustration. The comparator consisted of a strip of bismuth about 3.5 cm long soldered end-on to a similar one of antimony, forming a junction J_3 just over the heater *H* of manganin. On account of the very satisfactory performance of this simple comparator shown the author has devised a more elaborate and convenient instrument, using the principle of differential thermo-junctions. Fig. 7 is a diagrammatic view of the connections. J_1 and J_2 are delicate, similar and opposed junctions of antimony and bismuth. H_1 and H_2 are similar heaters of a single short length of manganin wire of 0.9 ohm resistance. Slow-motion screws permit delicate variations of distance between the junctions and their respective heaters. The double-throw switch S_1 has two poles above and three below, S_2 is four-pole and double-throw. The two heaters and their corresponding junctions have a heavy shield which is not shown in the diagram. To compare an alternating current with a direct current, the very simple procedure is to put H_1 and H_2 in series by means of the switch S_1 thrown up. The current to be measured, or a stronger one, is then sent through the heaters by throwing S_2 down. The distances of H_1 and H_2 from the junctions are then adjusted until the galvanometer shows no deflection. Now, since

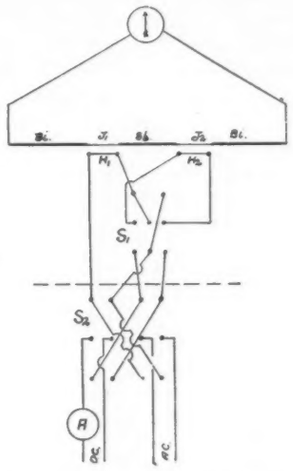


FIG. 7.—DIAGRAM OF CONNECTIONS.

the same current through H_1 and H_2 causes no deflection of the galvanometer, equal currents through H_1 and H_2 will cause no deflection. Then by simply throwing S_1 down the alternating current is sent through H_1 and a direct current through H_2. This equality is secured by adjusting the strength of the direct current. Then the current value is read from the standard ammeter *A*, or by means of a potentiometer and shunt if higher accuracy is desired.—*Phys. Review,* November.

Electrometer.—R M. SAYERS.—The author describes a modified Dolezalek quadrant electrometer which he has found very useful in testing laid submarine cables. The method of using

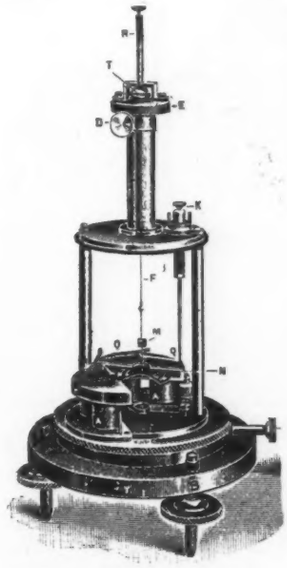


FIG. 8.—VIEW OF ELECTROMETER.

the instrument is given in detail, supplemented by comparative tests made with the galvanometer and the electrometer. Fig. 8 is a general view of the instrument with the case removed. The "needle" *N* (of paper thinly coated with metal, of buckled form, ensuring ample rigidity) carrying the mirror *M* is suspended by a quartz fiber *F*, which is detachable, being provided with a rectangular hook at each end engaging with eyes upon the torsion head and needle respectively. With these hooks,

which are of square section aluminum wire, no slack or backlash is experienced, and fibers of various dimensions may be rapidly interchanged. *QQ* are the brass quadrants mounted on ambroid insulators; *AA*, the opposite pairs of quadrants, being connected as usual. In the figure two adjacent quadrants are shown swung open on a hinge, to allow of access to the needle. The two pairs of quadrants are connected to the terminals on the underside of the base, not visible in the figure. The needle is charged by means of the switch *K*, which consists of an insulated terminal with a brass rod projecting downward and carrying a light strip of phosphor-bronze at its lower end. By turning the terminal the strip can be brought into contact with the needle and then withdrawn. The whole instrument can be rotated in azimuth about the base *B* and clamped in any position by the screw *S*. The ebonite torsion-head *E* is clamped by the screw *D*, and carries a brass rod, *R*, from an eye in the lower end of which the quartz fiber is suspended. This rod has a vertical adjustment controlled by the nut *T*, by means of which the height of the needle in the quadrant box can be varied. The brass cover (removed in the illustration), which serves as a shield from strong electrostatic fields, can be independently turned so as to make the lens *L* face in any desired direction. The author works with a lamp and scale having 500-mm divisions at a distance of 1.5 m from the electrometer. To obtain rapid swings of the needle an electromagnetic damping attachment is provided.—Lond. *Electrician*, Nov. 12.

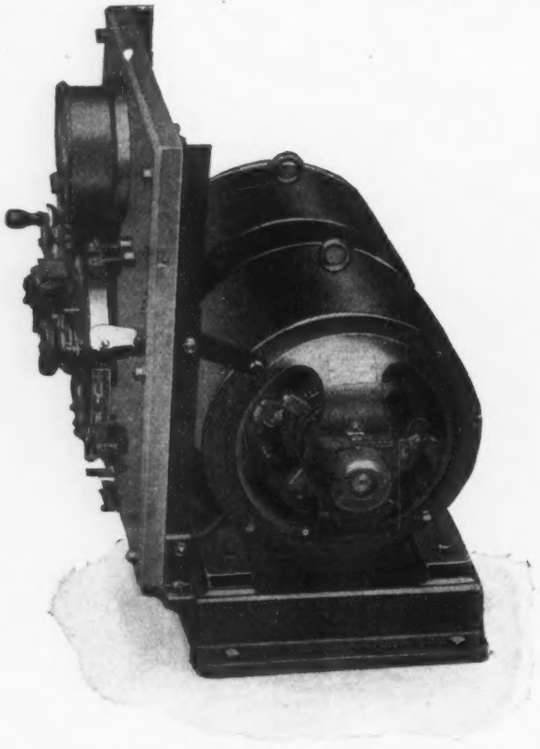
Miscellaneous.

Belgium.—An article on the electrical industries in Belgium in 1906. Belgium electrical industries produced 4000 generators of an aggregate rating of 92,000 kw. In 1906, 150 towns were electrically lighted. In 75 of these there was a power plant. More than 200,000 telephones are made per year. The capital invested in various electrical industries in Belgium is $5,000,000 and the number of employees is 6000. Some figures are given on telephony and telegraphy and on technical education in Belgium.—*L'Industrie Elec.*, Nov. 10.

NEW APPARATUS AND APPLIANCES

Lighting System for Use with Hand-Regulated Arc Lamps.

The Helios Manufacturing Company, Philadelphia, Pa., has devised a lighting system for use with all makes and types of hand-regulated arc lamps. A standard motor and generator are coupled together, and controlled from a small operating switchboard. All connections are made on the back of the board, so that the wiring from the main circuit need only be attached to the proper posts, and the wires leading to the lamp to terminals provided for them. When the motor is brought

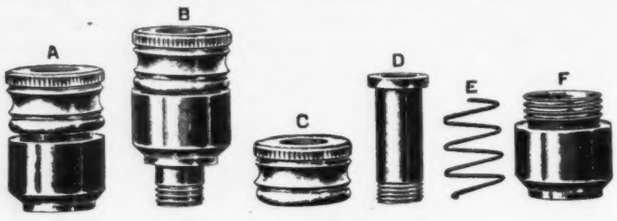


COUPLED MOTOR AND GENERATOR.

up to speed in the usual manner, the generator supplies energy to the lamp, and the lamp operates exactly as though fed from standard circuits through a rheostat. All the connections between the motor, generator and switchboard are made complete. The latter contains a voltmeter, which shows the voltage of the generator, and as no resistance is used between the generator and the lamp the voltage of the arc will be indicated also. The starting box for the motor is mounted on the board, and is of the under and-overload release type, so that the motor is fully protected. In addition two sets of fuses are provided, controlled by a double-throw switch, so that should one set blow the other may be at once thrown into service, and the blown fuses replaced at leisure. A field rheostat is mounted on the board to control the shunt circuit of the generator, and thus the voltage at the lamp terminals. The object of the apparatus is, of course, to cut down the losses occasioned by the use of resistances employed for reducing the voltage to that required by the arc.

Shock Absorber for Tungsten Lamps.

The Just-Tungsten Illuminating Company, of New York City, has brought out the lamp protector illustrated herewith. The device is quite simple, and forms a necessary adjunct to the installation of tungsten lamps subject to vibration. As is well known, the tungsten filament is quite brittle, and shocks, jars, etc., soon cause the lamp to become useless. The brass tungsten protector absorbs the horizontal as well as the vertical vibrations, thus guarding the filaments of the lamps against breakage from these causes. The device is installed between



PARTS OF SHOCK ABSORBER.

the fixture and the socket. The protector without load is shown at *A*, and with load at *B*. *C* is the detail of the upper part of *A* and *B*, and *D* is the inner brass tube with a thread in the lower end. *E* is the spring surrounding the tube *D*, and *F* is the lower part containing the tube and spring. The upper part is connected with the fixture, and the wire is run through the protector and connected with the lamp socket. The latter is connected with the thread shown in *B*, and when equipped with lamp and shade the flange in the upper end of *D* pulls down the surrounding spring, and holds the load in an elastic swinging state, thereby giving the lamp the necessary protection.

Cable Tester and Trouble Finder.

The location of troubles in telephone cables has always been practically beyond the reach of the manager of the medium and small-size exchange, and there are but few men sufficiently expert with the Wheatstone bridge to enable them to locate troubles such as shorts, grounds and crosses with certainty, and when wet cables are to be tested the majority are unable to effect any test whatever. In most cases they are obliged to locate approximately, and have the troubleman ride the cable to find the fault, and oftentimes if there is no outside indication on the sheath the fault is not found at all. This uncertainty is due to several causes, such as the constantly changing temperature at different points along the cable; the fact that the wires on the outside layers are affected more than those of the core or inner layers; the marked variation in the length of the wires, those near the core being very much shorter than those on the outside, especially in cables of large size, and also to the sag of the cable; so that a combination of these conditions makes it difficult to locate a fault with a bridge exactly. The Electric Specialty Manufacturing Company, of Cedar Rapids, Ia., has brought out a wireless cable tester, the result of several years' experiments by Messrs. George A. Bishton and J. E. Matteson, wire chief and cableman respectively of the Cedar Rapids & Marion Telephone Company. The tester was brought to its present state of efficiency about 18 months ago. It consists of a sender or vibrator, a head telephone receiver and a special selector or detector coil. The latter is so constructed as to kill the inductive effects of the foreign current on the cable sheath, and at the same time to permit the tone from the sender to be distinctly heard. The working of the tester under the many different and difficult conditions is due to the circuits and connections provided, and the manufacturer claims that troubles may be located exactly on all grounded, crossed, short and wet pairs in cables of any length or size. It is said that on grounded, short or crossed lines the tester will locate the fault exactly without exterior evidence on the sheath. Troubles from wet cables are as easily found as some of the other faults. When there is but slight moisture difficulty is experienced, owing to the very high and variable resistance. In such cases the instrument has been used to dry out the dampness and clear the fault. The instrument is usually connected at the office end of the cable to the wire or wires in trouble. The vibrator when started sends out a tone wave of high frequency so regulated, when properly connected, as not to interfere materially with the working lines in the cable. The troubleman usually makes his first tests where the cable leaves the office, or underground, to see that the instrument is working, then by going to about the center of the cable he can, by climbing three or four poles, run the trouble down to a very small space, and finally, by the use of a cable car, locate it exactly. Tests are made by placing the detector coil against the cable sheath, which permits the tone to be distinctly heard in the receiver, and as soon as the fault is passed the tone stops. No bridge measurements are necessary, but where the bridge is being used extensively the tester is of value as an auxiliary, since it is found necessary to make only approximate measurements, and by sending the cableman with his repair outfit to within a short distance of the trouble it can be readily located and repaired. Three good dry cells are all that are necessary to operate the instrument successfully.

FIG. 1—LOCATING TROUBLE WITH DETECTOR COIL.

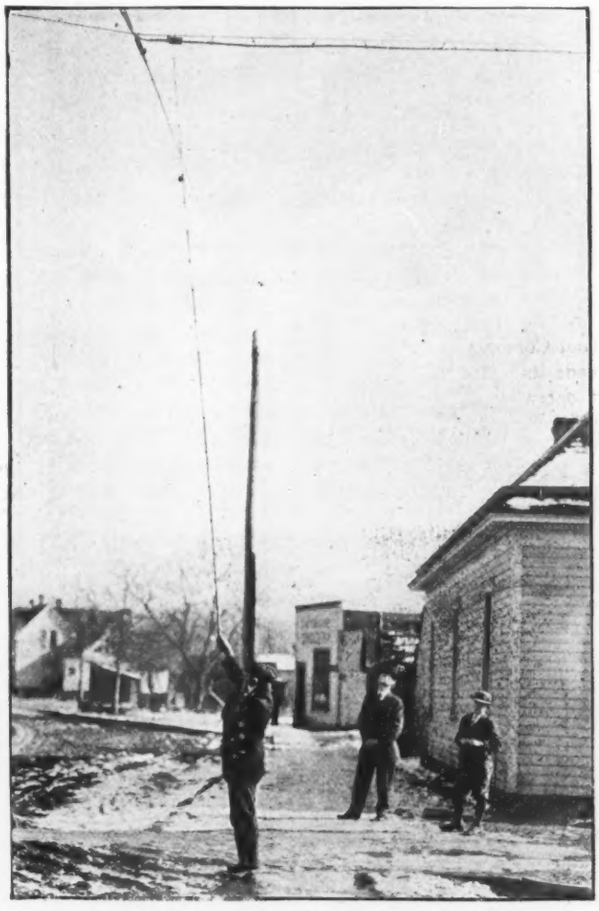
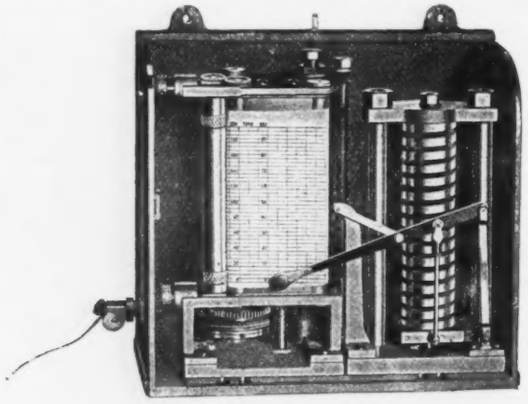


FIG. 2—DETECTOR COIL ON END OF FISH POLE.

Exposed Spring Indicator.

An exposed spring indicator embodying several features of importance has been brought out by the American Steam Gage & Valve Manufacturing Company, of Boston, Mass. Owing to the short piston rod which the spring surrounds, the manufacturer states greater uniformity and accuracy of re-

sults are obtained, since the shorter the piston rod the less liability there is to binding. The new type of exposed spring does not necessitate increased length or weight of the piston rod to any appreciable extent and thus avoids any increase of inertia in the moving parts. The design is said to secure all



EXPOSED SPRING INDICATOR.

the accuracy originally gained with a short piston rod, with the advantages which all exposed or outside springs possess of being impervious to the effects of heat or cold and readily changed.

Electric Hammer.

A new electric hammer, produced by the Electro-Magnetic Tool Company, 115 South Clinton Street, Chicago, has recently made its appearance on the market. The principle upon which it operates is that of an electromagnet, but in this tool the difficulties which have heretofore been encountered in applying this principle have, it is stated, been entirely overcome by the employment of a new principle in construction. The product

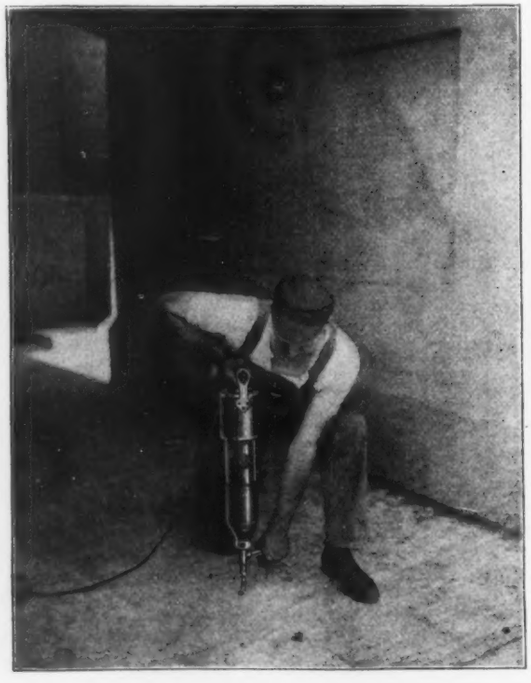


FIG. 1—ELECTRIC HAMMER IN USE.

of the company is designated as its "Model 5" hammer, recommended for drilling concrete, brick and stone. (See Fig. 1.)

The detail parts of this tool are shown in Fig. 2. The frame consists of two pieces of steel tubing *A* and *B*, separated by a brass gear case *C*, and bound together by two tie-rods *D*. The nose-piece *F* is of cast aluminum. In the lower section of the hammer frame is located an electromagnet *H* designed to exert a pull of 100 lb. Within the solenoid is a sleeve *J*, operated through the gears *M* and *N* and the connecting rod *E* by a series motor *K*, installed in the upper portion of the hammer

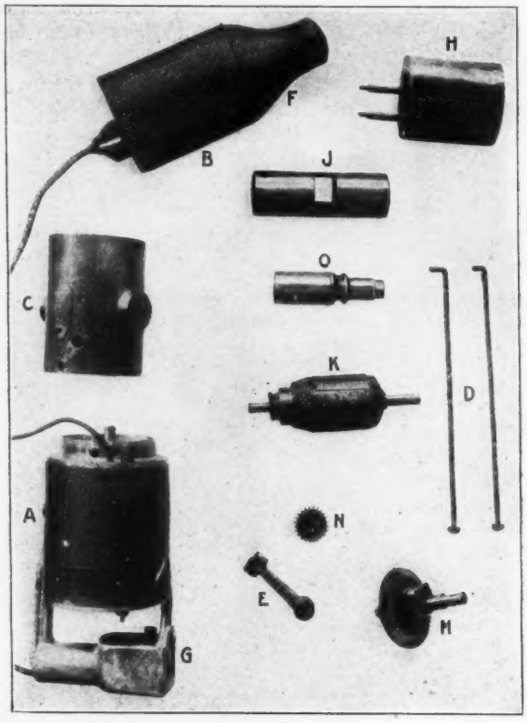


FIG. 2—PARTS OF ELECTRIC HAMMER.

frame. The hammer element *O*, weighing approximately 2½ lb., is located inside the sleeve, and is not connected mechanically or electrically with any portion of the drill, being absolutely free to move. The gears, sleeve and plunger are case-hardened, and all interior nuts and bolts are securely fastened. The bearings are of Tobin bronze and are provided with adequate means of lubrication.

The principle of operation may be readily appreciated by reference to Fig. 3. The sleeve *J*, which lies within the electromagnet *H*, is open in the center; the two ends are held together by three small struts, and the hammer element *O* lies within this sleeve. Current passing through the solenoid *H* produces a powerful magnetic field. The path of this field being through the hammer casing *B*, the steel heads *LL* through the sleeve *J*, till the opening is reached, thence into the plunger *O*, back into the other portion of the sleeve to completion. The plunger, being free to move, will tend to take up a position exactly midway of the sleeve. This sleeve, however, is reciprocated by the action of the motor *K* through the gears *M* and *N*. The sleeve starting on its stroke is not followed directly by the plunger until it has reached a point where the concentration of the magnetic pull is sufficient to overcome the inertia of this element. The plunger will then follow the sleeve on its stroke in an attempt to assume its normal position—that is, exactly midway of the sleeve. Before this has been accomplished, however, the sleeve has started upon its return, and the magnetic pull is gradually concentrated upon the other end of the plunger until this motion is likewise reversed. The hammer element, therefore, flies first one way and then another in an attempt to keep constantly midway of the sleeve. On its forward flight it impinges on the drill shank *P*, delivering a true hammer blow. On its return flight it is automatically brought to rest by the action of the magnetic field; but as the plunger is not mechanically connected to any other portion of the hammer, and as the magnetic pull is not suddenly applied,

but gradually concentrated, there are no sudden strains or jars placed upon the gears or crank shaft by the blow. The magnetic connection acting with a cushioning effect is stated to be even superior to that produced in an air hammer by early admission.

The electric circuit remains unbroken and always in the same direction. Make-and-break contacts and reversing devices are therefore eliminated. The operation of the tool is controlled entirely by the switch in the handle, which is only operated to start or stop the tool. The motor and solenoid being connected in parallel, the breaking of the circuit, in stopping the drill, automatically short-circuits the electromagnet through the motor, thus preventing any inductive kick from the coil.

The placing of wooden strips or inserts in concrete buildings has never been a success, and the practice of laying conduit imbedded in concrete during the construction, in the majority of buildings, has mitigated materially against the flexibility of arrangement. The cost of drilling holes has been so high as almost to prohibit open conduit work. The hammer described, which strikes 1450 blows a minute, so decreases the cost of

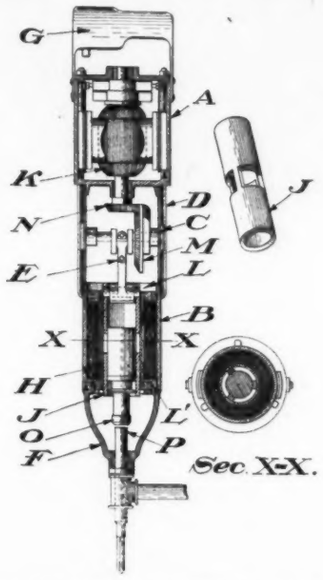


FIG. 3.—SECTIONAL VIEW OF HAMMER.

drilling holes for expansion bolts as to make this practice cheaper than the less satisfactory methods.

It is claimed that the tool can be counted upon to do as much work as five or six men using hand tools. Several companies can now drill 1000 holes per day, 2 in. deep and 9/16 in. in diameter, using this tool, where formerly 50 to 75 holes were a day's work. The amount of power required is so small that the hammer may be operated directly from lighting circuits; and as it is portable and may be operated in any position or at any angle, it makes a particularly attractive tool for contract work.

Three-Phase Transformer.

The three-phase transformer presents certain inherent advantages of compactness in construction and installation, since it supplants with a single piece of apparatus the equivalent group of three single-phase transformers otherwise required for the same service. The simplicity of connections and the better appearance presented by the three-phase transformer when installed on a pole or elsewhere have led many to prefer it for electrical distribution to the equivalent arrangement of three single-phase transformers.

The accompanying illustration shows a Westinghouse Type C three-phase transformer in which, it is stated, marked improvement has been introduced, resulting, besides the advantages already enumerated as inherent to this design, in decided advances in both construction and performance. In these transformers the losses are reduced below those of any ordinary equivalent combination for transforming three-phase power, while experience in design and modern factory methods have produced a highly serviceable apparatus that can be sold below the price of the equivalent single-phase transformer group.

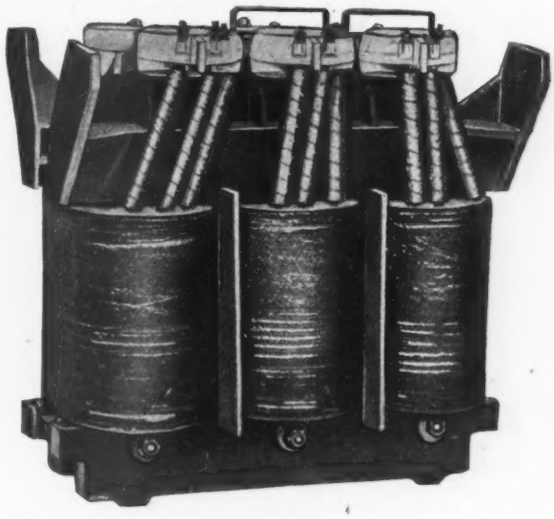


FIG. 1.—THREE-PHASE TRANSFORMER, WITH CASE REMOVED.

The transformers are made in sizes ranging from 5 kw to 75 kw capacity, and display very high efficiency at all loads, as well as close regulation when operating on currents having low power factors. These properties of good regulation and efficiency, together with compactness and simplicity, make them especially adaptable for supplying motor loads.

The cast-iron corrugated case employed is quite similar in design to that used in the other recent types of Westinghouse transformers. The three high-tension leads enter from the front side of the transformer, the low-tension secondaries issuing from the pole side of the case. Provision has also been made for bringing out neutral leads, when desired, from both the high-tension and low-tension windings. Separate terminal blocks are provided for both the high-tension and low-tension leads of each of the three phases. Each low-tension winding

FIG. 2.—THREE-PHASE TRANSFORMER.

comprises two coils, which can be connected in parallel for 110 volts or in series for 220 volts, the standard design being for 2200 volts on the high-tension side. In general, the design and construction are developments of the Westinghouse single-phase lighting transformer.

Meter-Testing System.

The accompanying illustrations refer to a meter-testing system designed to solve many of the perplexing meter-testing problems of the past. This new system permits of the installation of meters in more accessible positions and enables the necessary tests to be made without breaking or making the service connections, as is absolutely essential with the older methods.

The principal element of this new testing system is the use of a new special testing device consisting of two elements as follows: A specially designed fused terminal block equipped with a National Code protecting case so designed as to receive the terminal block and also to enclose the terminals of the service meter. It is intended that the entire device will be permanently mounted on the consumer's premises and form a part of the service connection.

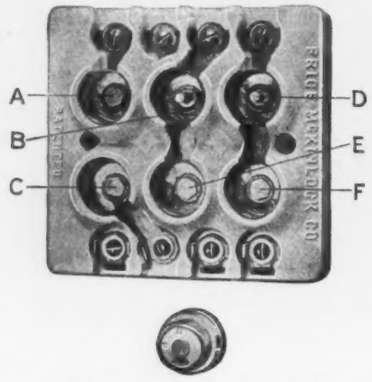


FIG. 1.—PORCELAIN TERMINAL BLOCK.

Fig. 1 illustrates the special porcelain terminal block which, as will be noted, is provided with six receptacles, four of which are of standard and two of which are of special construction. The standard receptacles will thus receive the regular Edison fuse plugs shown in the illustration, while the special receptacles, being provided with center studs, require the use of special testing plugs shown in Fig. 2.

These testing plugs are provided with suitable socket terminals which receive flexible test cords, as shown in Fig. 3. Two forms of plugs are employed, these being known as test plugs and fuse plugs. The fuse plugs are intended to protect the service and test circuits against accidental short circuits during test and the test plugs are employed to make connection between the measuring coils of the service and the standard meters.

FIG. 2.—TESTING PLUG.

FIG. 3.—PLUG WITH SOCKET TERMINAL.

This combined installation and testing scheme, which is being placed on the market by the Central Electric Company, Chicago, is adapted for use with the various types of commercial meters, as many forms of enclosing boxes are supplied to fit the different types. A typical test connection is shown in Fig. 4 in which a service meter is being tested by means of a rotating standard and an artificial load box. It will be noted that the line or load wires have not been disturbed, or the consumer's service interfered with. Furthermore, in connecting up for the test it was not necessary for the meter tester to use screwdrivers or pliers nor untape or retape joints.

It will be understood that the special test plugs and cords are simply in use at the time of making tests and are then replaced by the regular Edison fuse plugs. The special porcelain testing block, in addition to offering facilities for test, also serves as a standard fuse block under regular service conditions. In designing the testing block every commercial meter on the market has been considered and provision has been made for its installation and test.

A permanent installation is shown in Fig. 5, the test having been completed and the cover sealed in place. Under these conditions service is absolutely protected from danger of current theft, as there are no bare connections exposed from which current can be tapped off.

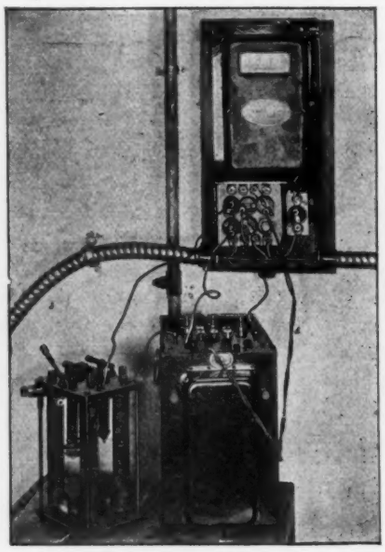


FIG. 4.—CONNECTIONS FOR METER TEST.

FIG. 5.—PERMANENT INSTALLATION.

Electric Drive for Printing Establishments.

The character of the service in printing establishments usually makes it desirable to install the individual motor drive. Among the principal advantages over other drives obtained by driving a press by an individual motor are positive and easily manipulated speed control through a wide range, low-operating cost, improved cleanliness, greater safety, decided space economy, and in general, much higher plant efficiency.

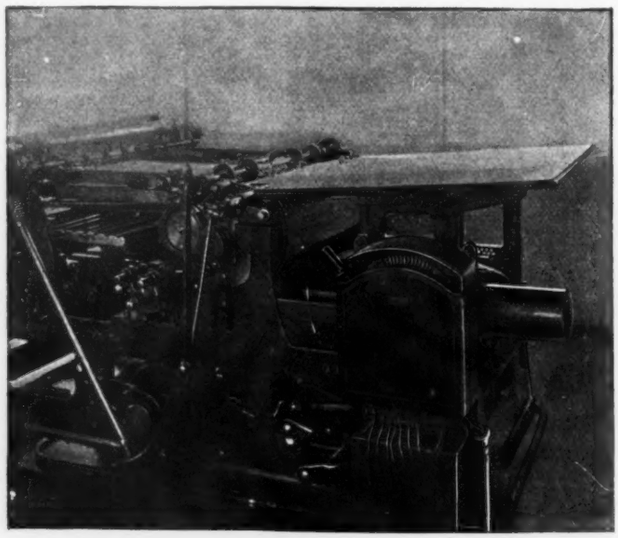


FIG. 1.—ARRANGEMENT OF CONTROLLER AND RESISTANCE ON PRESS.

The General Electric Company has developed a type of single-phase motors, known as type R I, which is claimed to provide

all these advantages. By means of controllers they give a variation of 50 per cent below synchronous speed with uniform and rapid acceleration and retardation. An installation of motors in the plant of a well-known job printing establishment in Warren, Pa., illustrates the adaptability of this type to work of this class.

The printing plant in question at first operated its press

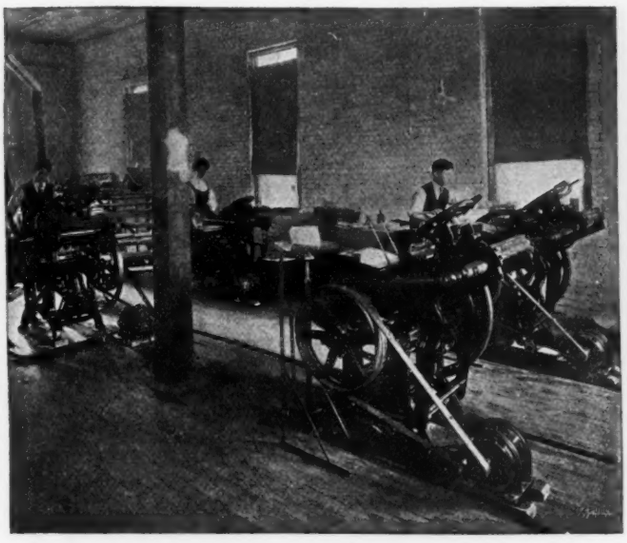


FIG. 2.—½-HP, VARIABLE-SPEED MOTORS DRIVING JOB PRESSES.

equipment by means of a 6-hp gas engine. Owing, however, to frequent shut-downs and generally unsatisfactory operation, the engine was replaced by a 6-hp direct-current motor. The improvement in service was so marked that in order to secure the added advantages of the individual drive in regard to speed control, etc., the proprietors decided to adopt still further refinements and so installed a General Electric single-phase motor to drive separately each of the five presses in use, as well as one stitcher. The final arrangement with individual drive brought about such marked improvements in regard to cleanliness, noise, operating costs, etc., that the owners have

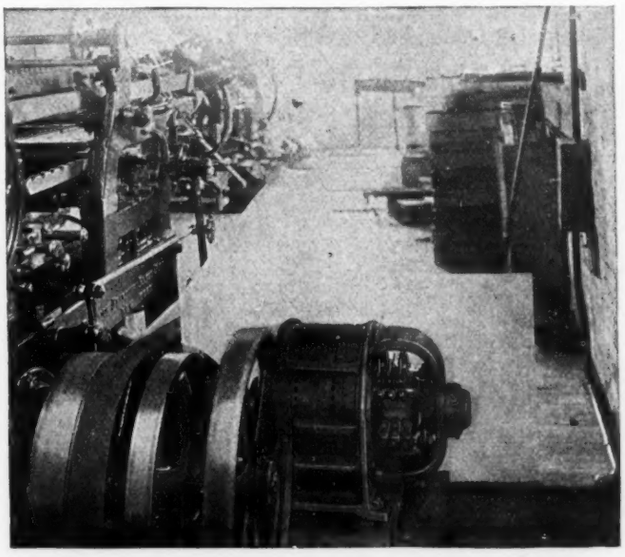


FIG. 3.—SINGLE-PHASE, VARIABLE-SPEED MOTOR ARRANGED FOR BELTED INDIVIDUAL DRIVE.

stated, after a thorough trial, that they are convinced "it is the perfect power. The flexibility of the motor drive makes it possible to get out better and more work at a very low power cost. The motors are little beauties and run like a charm. It is certainly surprising how much lighter, cleaner, and quieter the plant is now than with the old shafting."

Some Special Features in the Design of a 2000-kw Generator.

The power plant which has recently been put into operation at the Packard Motor Car Company's plant at Detroit has several novel features in its design. One of these is the 2000-kw direct-current Hawthorne generator, which is direct driven by

FIG. 4.—PRESSES OPERATED BY SINGLE-PHASE MOTORS.

a Cooper horizontal cross-compound engine. The unusual feature about this generator was the fact that the question of shipment was the chief factor of its design. The whole generator was shipped practically in pieces and assembled at the plant. The frame was 22 ft. 1 in. in diameter, weighing 24 tons, so that one-half of the frame when loaded on the car for shipment stood a little over the railroad limits for clearing. In order to ship the frame, therefore, special arrangements had to be made with the railroads between the shipping point at the Hawthorne works of the Western Electric Company and the works of the Motor Car Company at Detroit.

Another special feature was the dividing of the armature center or spider, and the bolting and keying of it on the engine shaft in a manner similar to the usual method of flywheel installation. The armature core laminations, after punching and japanning at the factory, were packed in boxes, and stacked to form the core after the spider was mounted on the shaft at the plant.

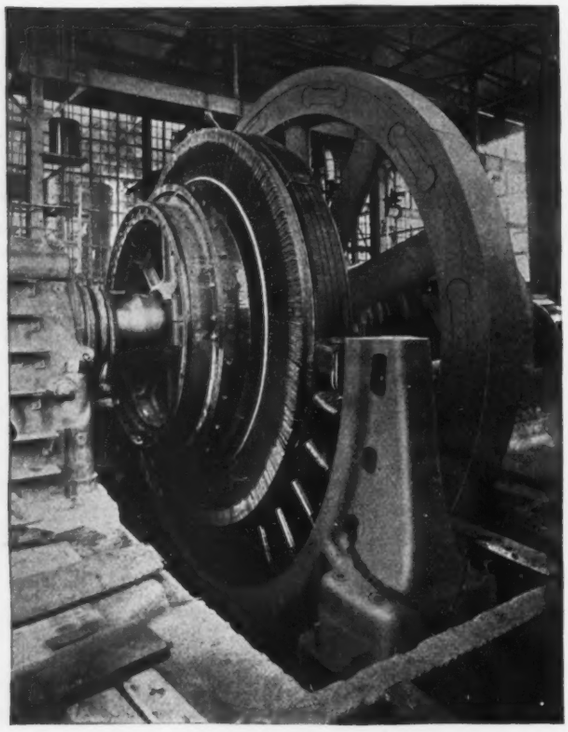
The commutator presented the most difficult problem. While the commutator proper is but 10 ft. 4 in. in diameter, the diameter over the tangs is practically the same as that of the armature, namely, 15 ft. 6 in. It was, therefore, necessary to split it. To divide and ship divided this annular ring built up of 816 copper and an equal number of mica segments was a very undesirable proposition, but it was done successfully. An accompanying illustration shows the generator just after the commutator was placed on the shaft. The ring around it was used to tighten it as much as possible. As soon as the windings were all in place the motor was run with a weak field, separately excited, and short-circuited. By this process the commutator was thoroughly baked. While still hot all the cap screws were brought up as tightly as possible. The commutator was then turned down and trued for operation.

During the time of erection not one part or piece had to be trimmed or fitted. Every part went together and fitted perfectly, although the machine was then being assembled for the first time.

For several weeks previous the Packard officials had planned a banquet on Oct. 8 in the engine-room to celebrate the completion of the installation. As a result the Western Electric Company's installers were so rushed to complete the work that no preliminary testing except for a few minutes to determine

the polarity and make tests for brush position could be made. The work of connecting up was completed but six hours before the banquet was served, yet when President Joy threw full load on the generator his guests saw it carry the load without a spark and without further adjustment.

To practically build a generator weighing complete approxi-

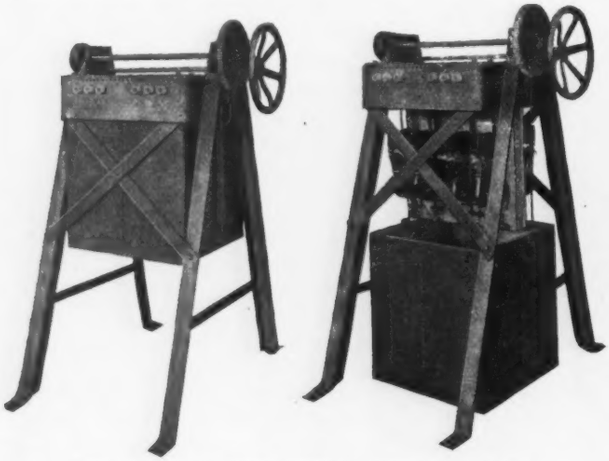


2000-KW, DIRECT-CURRENT GENERATOR.

mately 107 tons and to put it into operation without a single extra fitting or adjustment speaks well of the judgment of the designers as well as the good work of the shop and installing forces.

High-Tension Contactor Panel.

A very desirable feature possessed by the electric motor as a source of power is the ease with which it lends itself to remote



FIGS. 1 AND 2.—HIGH-TENSION CONTACTOR PANEL.

control. The panel shown in the cut is designed to control a 750-hp, 2080-volt, squirrel-cage-type induction motor. This motor drives a centrifugal pump used in connection with a suction dredge to assist in forcing the material through pipes in order that it may be discharged at a distant point. Owing to the high voltage the contactors for connecting the motor to the compensator and to the line after the starting period are oil immersed.

The motor and panel are located at a distance from the dredge, and the panel is designed for control from the dredge, as there will be no attendant at the point where the motor is installed. The overload device on the control panel is so connected that in case the motor becomes overloaded, the control circuit is opened at the dredge and this in turn opens the motor circuit by means of the contactors, thus making it possible in case of a temporary overload to start the motor again from the dredge. In Fig. 2 the oil receptacle is lowered to permit inspection of the contactors. This panel was manufactured by the General Electric Company at its Schenectady Works.

Remote Control Switch.

The accompanying illustrations give two views of a 300-amp, three-pole Darrin magnet main-line switch for the remote control of motors or lamps. These switches are particularly useful in connection with alternating-current motors where it is de-

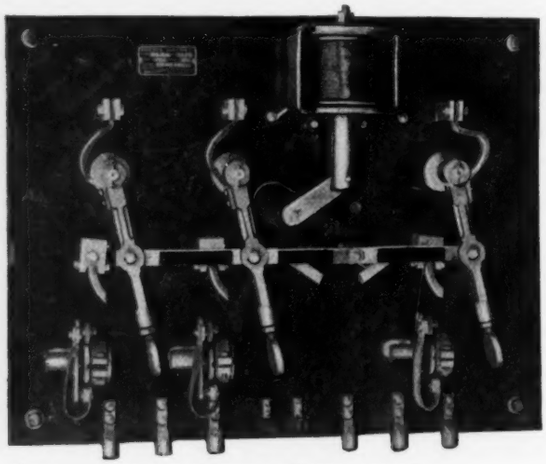


FIG. 1.—REMOTE CONTROL SWITCH.

sirable to do away with the heating and noise occasioned by laminated magnets carrying current continuously. The switch magnet carries current only during the actual operation of throwing the switch open or closed. In the illustrations lami-

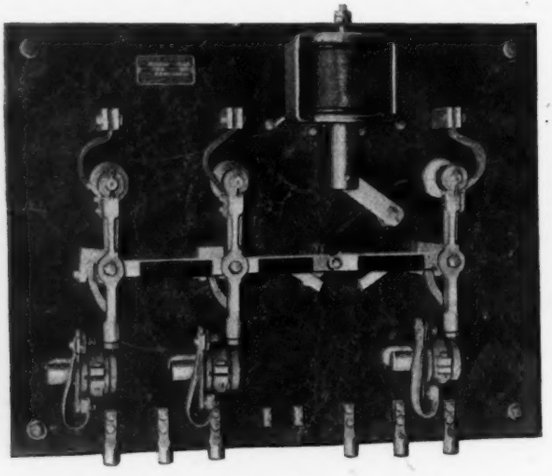


FIG. 2.—REMOTE CONTROL SWITCH.

nated final current-carrying contacts are shown, these contacts being necessary where heavy currents are carried. A large number of these switches will be used in the new building of the Prudential Life Insurance Company at Newark, N. J.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There was considerable improvement in retail trade during the past week, according to reports received from all parts of the country. Colder weather and the approach of the holiday season have done much to stimulate buying, although in some rural sections continuous rains and snows have made the roads temporarily almost impassable. Wholesalers and jobbers report a fair number of orders, especially reorders, and numerous inquiries for spring business. In manufacturing lines it is the same old story of expansion. This is especially true with regard to the iron and steel business, where the bookings for October and for the first three weeks of November have been so large that it has been necessary to advance prices, and to refuse orders except for distant deliveries. Rail orders during the past week were fairly liberal, and it is known that many heavy specifications have been drawn which will soon materialize into orders for delivery during the first half of 1910. Overtime is the general rule throughout the Pittsburgh section, and there are complaints over the scarcity of skilled labor. The demand for structural material also continues to be very large, and the building industry is almost as flourishing as it was at the beginning of the summer. Railroad traffic continues to expand, the weekly reports show a vast increase in earnings and in some sections there is complaint from the shortage of cars. Collections improve with each week, and are fairly satisfactory at this time. Business failures for the week ended Nov. 25, as reported by *Bradstreet's*, were 217, as compared with 232 the previous week, 193 in 1908, 258 in 1907, 174 in 1906 and 188 in 1905.

THE COPPER MARKET.

The striking buoyancy which stirred the copper market during the past month was checked in a marked degree during the past week by the uncertainty as to the success of the proposed merger of heavy producing interests. Many conservative observers are of the opinion, since reading the decision in the Standard Oil case, that the copper merger as outlined would be a more pointed violation of the Sherman law, as now interpreted, than the Standard Oil. It is being organized for the avowed purpose of "controlling prices" and regulating production. These are the exact crimes of which the oil company has been found guilty. The growth of this impression has not only broken the prices of copper stocks in the Wall Street market, but it has almost stopped all buying in the metal market. Consumers who rushed in alarm to stock up, before the market was "in control," see no reason for haste under existing circumstances, and many of them are beginning to repent their rashness, in view of the adverse statistical position. The negotiators of the merger still assert with confidence that the court's decision does not apply to their plan and that it will be carried out as projected. During the past week prices of copper have been lower and takings light. For the month of November, however, sales have been heavy both at home and abroad. Exports up to and including Nov. 29 were 21,391 tons, indicating shipments of about 50,000,000 lb. The daily call on the Metal Exchange Nov. 29 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	13.00	13.25	....
November	13.00	13.25	13.12½
December	13.00	13.25	13.12½
January	12.87½	13.12½	13.00
February	12.87½	13.12½	13.00
March	12.87½	13.12½	13.00

The London prices Nov. 29 were as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	58	5	0	58	5	0
Standard copper, futures	59	7	6	59	7	6
Market	Weak			Steady		
Sales of spot				700 tons		
Sales of futures				2,400 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.45			12.12½		
London, spot	£64	2	6	£54	12	6
London, futures	64	17	6	55	10	0
London, best selected	67	15	0	59	0	0

UNITED STATES GAS & ELECTRIC COMPANY.—William T. Morris, who was formerly connected with the Associated Gas & Electric Company, has sold out his holdings in that concern. The fact that this company had taken over a number of properties formerly held by Mr. Morris, and would be operated by W. S. Barstow & Company, of New York, was published in our issue of Oct. 14. At that time it was stated that Mr. Morris personally had retained control of the Lyons (N. Y.) Gas Light Company, the Newark Gas Light & Fuel Company, the Oswego Gas Light Company, the Palmyra Gas & Electric Company and the Penn Yan Gas Light Company. Mr. Morris has now formed the United States Gas & Electric Company, incorporated under the laws of New York, with general offices at Penn Yan, to take over and operate these properties. The charters of this company and of the Associated company were issued a number of years ago, but no organization was made until recently.

GENERAL ELECTRIC COMPANY'S ILLUMINATING ENGINEERS.—The General Electric Company has arranged to centralize the department of its illuminating engineers; in other words, all of the illuminating engineers of the company, which number 10 or 12, will hereafter do their work and make their homes in Schenectady. The building which was formerly the power station of the Schenectady Illuminating Company is being transformed into an office building, with laboratories and exhibition rooms, and will be the headquarters of the illuminating engineers of the company. William D'A. Ryan, the chief illuminating engineer of the company, and who has been located at Lynn, Mass., will be in charge of the new offices at Schenectady. The engineers who have been employed at Harrison will also be located in Schenectady.

CROCKER-WHEELER CANADIAN PLANT.—The Croker-Wheeler Manufacturing Company, of Ampere, N. J., has decided to establish a Canadian branch at St. Catharines, Ont. The company has purchased the old Ross factory from the city corporation which it is going to enlarge. The company agrees to begin operations with 100 first-class mechanics, but it is expected that this force will be very greatly increased within the next few years, as the company does a big business in Canada upon which there is a duty of 30 per cent. It is reported that the company has secured a contract for machinery for the Winnipeg municipal plant amounting to about $250,000 which will be manufactured at the St. Catharines works. The company has heretofore maintained an office at Montreal, but it will be removed to St. Catharines.

GENERAL MOTORS COMPANY EXTENSIONS.—Plans have been drawn by the General Motors Company for the erection of a $2,500,000 plant in Detroit. A tract of 50 acres has been secured on which 14 large modern factory buildings will be erected. The company has acquired quite a number of important automobile manufacturing concerns and since it increased its capital stock several months ago it has been the intention of the officials to erect a large central plant in Detroit.

PROPOSED WISCONSIN ELECTRIC RAILWAYS.—John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, in a recent address at Whitewater, Wis., said that he intended to build an interurban line between Watertown, Ft. Atkinson, Jefferson and Janesville in a few years. He stated that spurs would then be built from the main road to Whitewater, Lake Geneva, Elkhorn and Delavan.

QUINCY ELECTRIC LIGHT & POWER COMPANY.—The Gas Commissioners of Massachusetts have been petitioned by the Quincy Electric Light & Power Company for authority to issue $50,000 of additional capital stock, the proceeds to be used to pay off floating indebtedness. The company asks to have the price of the new stock set at 110 per share.

ALLEN & CALVES, COMITAN, MEXICO.—It is announced that Allen & Calves, Comitan, Chiapas, Mexico, have leased for a term of years the electric light plant of Francisco Orozco y Jimenez, and also that of Paniagua y Garcia, in the city of San Cristobal, L. C.

MEXICAN NORTHERN POWER COMPANY.—A meeting of the shareholders and bondholders of the Mexican Northern Power Company was held in Montreal on Nov. 17, when authority was given for an increase in the bond issue from $7,500,000 to $10,000,000, and the capital stock is to be increased from $10,000,000 to $15,000,000. The company has obtained valuable concessions for the erection on the Conchas River in the State of Chihuahua in Mexico of extensive hydroelectric and irrigation projects. An immense dam will be constructed which will probably be the largest in the world, having a sufficient storage capacity to operate a plant generating 40,000 hp. There will be two transmission lines, one to the City of Chihuahua on the north and Peral on the west. Between these places are many towns and mining camps of great importance. A census showed that an aggregate of 30,000 hp is actually installed in these places. The power is now generated by steam from wood and coal, which are exceedingly costly and scarce. The dam will be located about 20 miles from St. Rosalie, an important city on the line of the Mexican Central Railway. The company has also secured a second water-power some 50 miles further up at Lajoca on the Conchas River, which will be developed later as a second installation, and which will when complete double the capacity of the company. It is estimated that within three years 20,000 hp will have been sold at a price of $100 gold per horse-power per annum. Construction operations were begun two months ago by the firm of S. Pearson & Company, Limited. The officers and directors are as follows: C. F. Greenwood, president; E. B. Greenshield, vice-president. Directors: Edwin Hanson, J. S. Moore, B. F. Pearson, Hall Gunther, S. M. Brookfield and J. D. Paterson.

WESTERN ELECTRIC COMPANY.—An official of the Western Electric Company, in discussing the deal between the American Telephone & Telegraph Company and the Western Union Telegraph Company, declared that his corporation had nothing to do with the new arrangement, and will not in any way be affected by it. "The consolidation of interests," said he, "is without any significance as far as the Western Electric Company is concerned. We are manufacturers of telegraph apparatus, and we sell to the Western Union, the Postal and any other customers who desire to buy such apparatus. We are also manufacturers of telephone apparatus, and we sell to the American Telephone & Telegraph Company, which is our largest customer, and we also sell other companies. We expect to maintain our trade entirely upon the price and quality of our products, which compare favorably with those of our competitors." The American Telephone & Telegraph Company owns practically all of the stock of the Western Electric Company, and it is very evident that the new deal cannot be detrimental to the business of the latter.

RUMORED CANADIAN ELECTRICAL MERGER.—The steady buying of shares in the Montreal Light, Heat & Power Company has given rise to a rumor that the Shawinigan Water & Power Company was acquiring the control of the former company. In an interview on Nov. 23, President J. E. Aldred, of the Shawinigan Water & Power Company, stated that the rumor that his company was seeking to obtain control of the Montreal Power Company is untrue. While it is true that the Shawinigan Company had acquired a substantial interest in the Montreal Company, it has been done with the full knowledge of the latter company. The relations between the two companies have been very friendly, and the acquirement of this interest was only a step further toward cementing these friendly relations. Mr. Aldred added that his company still had at its disposal 75,000 hp.

NEW WISCONSIN INTERURBAN LINE.—The Cincinnati Construction Company, recently incorporated to build an interurban line between Madison and Janesville, has made application to the State Railroad Commission for an order of necessity to lay and operate an electric road between these two cities. John A. Aylward, the company's attorney, made the application. An amendment changing the location of the company from Janesville to Madison has also been filed. It is stated that the company has secured the right-of-way of more than half the distance and holds options on the remainder of the route. Attorney Aylward states that a larger part of the construction material has been contracted for, and that work will be started as soon as possible in the spring. Mr. Zigler is president of the Cincinnati Construction Company.

NIAGARA, LOCKPORT & ONTARIO POWER COMPANY.—The American Locomotive Company has just closed a contract with the Niagara, Lockport & Ontario Power Company for energy to operate the former's plant at Dunkirk, N. Y. In addition to this, the Niagara company has extended its contract with the Buffalo, Lockport & Rochester Railway from 3 to 25 years, under an arrangement by which the power company will use the railway company's 60,000-volt transmission line from Lockport to a point within six miles of Rochester. This line will enable the power company to serve a large number of towns along the line of the railway, and will also form an auxiliary to the transmission line of the power company between Lockport and Rochester.

COLORADO TELEPHONE COMPANY.—Plans are being prepared by the Colorado Telephone Company for enlarging and improving the system in Denver, Col., and also in the State of Colorado and in the Territory of New Mexico. The scheme now under consideration will involve an expenditure of about $1,500,000. A new exchange will be opened and a new office building constructed in Denver, and wires will be placed underground in that city. A new system and improvements will be placed in a number of other towns that are reached by the company. It is said that a line will be constructed over the summit of the Cambres Mountain from Almosa to Durango, with an extension to Gunnison, about 200 miles in length.

BIG ORDERS FOR ELECTRIC EQUIPMENT.—It is stated by a financial authority that the makers of electrical apparatus, rolling stock, rails and other supplies for electric railways in the United States have now on hand orders which will amount to about $47,000,000. It is estimated that the electric railways of the United States have to-day an actual physical valuation of $2,250,000,000. In addition to this, important specifications have been approved for the electrification of about 650 miles of steam railroads. Many of these specifications have been held up awaiting the general resumption of business before being carried out.

GREAT NORTHERN ELECTRIFICATION.—Plans are being prepared by the Great Northern Railway Company for the construction of a plant in the Lake Chelan country, which will develop about 80,000 hp. This is in connection with the present plant at Leavenworth, Wash., which has an output of 12,000 hp. It is said that the purpose is to equip the entire western division of the railroad for electric operation. The plant that is now in operation hauls trains through the Cascade Tunnel.

HORNELL-BATH INTERURBAN COMPANY.—Application has been made to the Public Service Commission of the Second District of New York for authority to construct an electric line between Hornell and Bath, in Steuben County, a distance of 23 miles, by the Hornell-Bath Interurban Railway Company. The road will pass through the towns of Hornellsville, Fremont, Howard, Avoca, and Bath. The company has also asked permission to issue $250,000 of common stock and $550,000 of bonds.

CANADIAN WATER-POWER ARBITRATION.—A board of arbitrators has been sitting for several days to determine the value of the water privileges on the Winnipeg River, of which the Hudson's Bay Company and the Kerwatin Power Company were expropriated by the town of Kinora. Three reports on the undeveloped water-power place the value from $5,000 to $48,000.

MONTREAL RAILROAD ELECTRIFICATION.—The Canadian Pacific Railway Company is collecting data relative to the electrification of its Windsor Street terminal in Montreal. The grade from the terminal to the Westmount yards is very heavy and causes the westbound locomotives to produce a great amount of smoke. The electrified section will probably extend to Montreal Junction.

CANADIAN ELECTRIC STEEL PLANT.—Operations were commenced on the building of the Electric Steel Company's experimental plant on Nov. 16. The present building will be 75 x 152 ft. It is expected that by 1912 about $15,000,000 will have been invested here in the company's plant and works. It is reported that there are a dozen very wealthy persons interested in the enterprise.

ELECTRIC MOTOR MANUFACTURERS' ASSOCIATION.—The next meeting of the American Association of Electric Motor Manufacturers will be held at Hot Springs, Va., in the month of May, 1910.

NEW YORK & NORTH SHORE TRACTION COMPANY.—The foundation work has already been completed for the new power house of the New York & North Shore Traction Company at Bayside Meadows, Long Island, and the work of construction will be rushed as rapidly as possible. Contracts for the electrical apparatus have been placed with the Westinghouse Electric & Manufacturing Company, and it is expected to have the station in operation by next February. This equipment consists of two 1000-kw turbine units; two 25-kw turbine exciters; four 300-kw rotary converters; four 333-kva three-phase transformers; one nine-panel and one five-panel switchboard. The surface work on the extension to Whitestone Landing has been done, and the iron poles for supporting trolley wires are being erected.

NEW ELLIS ISLAND ELECTRIC PLANT.—Contracts have been let by the Commissioner of Immigration for the erection of a new power plant on the main island at the Ellis Island Station. The old machinery will be moved to the buildings on the southern island and the new plant utilized for the main buildings. The plant is being constructed by Evans, Almirall & Company, 281 Water Street, and the contract for the electrical apparatus has been awarded to the General Electric Company. The plant will be equipped with one 300-kw and two 125-kw direct-connected horizontal turbine generators and switchboard. The energy will be used for lighting and for operating pumps, including high-pressure pumps for fire service. The plant will be ready for operation about March 1.

BRASS PRICES ADVANCING.—Further advances in commodities in which copper plans an important part have been made within the past 10 days. Brass manufacturers have advanced their prices ¾ of a cent a pound, and the base for brass rods, sheet and wire is now 14 cents. Brazed tubing remains unchanged at 19⅛ cents. The manufacturers of copper wire have made their third advance within the past month of ¼ of a cent a pound, and the base for bare and weather proof wire has now been raised to 15¼ cents a pound. It is said that wire people have been the heaviest buyers of copper within the last few days, and that the wire mills are now preparing to operate on full time.

SWEDISH GENERAL ELECTRIC COMPANY IN CANADA.—Harry D. Bayne, for many years manager of the Canadian branch of the Westinghouse Electric & Manufacturing Company, has acquired an interest in the General Electric Company of Sweden, and has opened an office for the transaction of the business of the company at Montreal. The Swedish Company has been doing business in Canada for some time, but in a somewhat limited way. Application will be made for incorporation in Canada, and under Mr. Bayne's management the business of the company will be vigorously pushed throughout the Dominion.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in Wall Street has been one of considerable demoralization and heavy selling pressure. There have also been evidences of more extensive bear operations than have appeared in the Street for many months. On the last day concerned in this report, Nov. 29, the bears made repeated attacks upon the market, and, in spite of some definite efforts to support prices, succeeded in forcing almost the entire list down several points. There was also considerable forced selling due to the exhaustion of margins, and in the present condition of the money market, and with the present uncertainty of financiers, wide margins are universally demanded. This condition in the security market is attributed by almost every trader to the panic created in the minds of many by the decision adverse to the Standard Oil Company. Before that decision the market had been buoyed up and carried along by the copper stocks, which were inflated entirely by the promises of a great merger which would control the copper trade. An analysis of the Standard Oil decision has convinced many that the same conclusions would be reached with regard to the proposed copper merger. This started heavy selling in copper shares, and Amalgamated and other coppers have sold off within the past week from 6 to 8 points. United States Steel, too, it is believed by many, might be in trouble if the Standard Oil decision is sustained by the Supreme Court. For this reason there has been heavy selling of steel shares, and the common closed at 86 Nov. 29, which was several points less than the close the week previous. Aside from this nervousness concerning the future of great industrial corporations, there is no reason for any demoralization in the stock market. Business conditions continue to improve, earnings, both of industrials and railroads, continue to advance and the money market shows no indication of becoming so stringent that operations will be hampered. The situation abroad is improved, and rates in this country are about the same as they have been for the past three weeks. Quotations Nov. 29 were: call, 4 @ 5 per cent; 90 days, 4¾@ 5 per cent.

NEW YORK.

	Nov. 22.	Nov. 29.	Shares sold.		Nov. 22.	Nov. 29.	Shares sold.
All.-Ch.	15	15½*	2,900	Int.-Met.,pfd.	54¾	54½	31,400
All.-Ch., pfd.	54¼	53¼	5,590	Mackay Cos..	94	92½	4,800
Amal. Cop...	92	84⅛	755,665	MackayC..pfd.	75⅞	76⅛	800
Am. D. T....	20½*	20½*	.....	Man. Elev...	140	139⅞	400
Am. Loc.....	61½	59¾	7,620	Met. St. Ry..	23*	23*	.....
Am. Loc.,pfd.	115	115	300	N.Y.&N.J.Tel.	139¼*	139¼	.....
Am. Tel. & C.	83*	83*	.....	Steel, com...	88⅜	86	843,400
Am. T. & T..	142⅝	140¼	24,836	Steel, pfd....	125	123½	16,020
B. R. T.....	77¾	77	18,232	W. U. T.....	77⅝	77½	5,390
Gen. Elec....	162	159½	7,000	West'h., com.	85⅞	81⅛	4,800
Int.-Met.,com.	22½	22½	61,020	West'h., pfd..	134½*	136½*	100

PHILADELPHIA.

	Nov. 22.	Nov. 29.		Nov. 22.	Nov. 29.
Am. Rys.....	45¼	45⅛	Phila. Elec....	13	13
Elec. Co. of A.....	12⅜*	12⅜	Phila. R. T.....	26½	25⅞
Elec. St. B'ty.....	58	58	Phila. Trac.....	89*	89*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	52½	52⅛

CHICAGO.

	Nov. 22.	Nov. 29.		Nov. 22.	Nov. 29.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	136*	135½
Chi. Rs., Ser. 1.....	100*	98	Met. El., com.....	17*	17*
Chi. Rs., Ser. 2.....	32	32	Met. El., pfd.....	53	51½
Com. Edison.....	119*	119	Nat'l Carbon.....	97	97
Chi. Subways.....	6	5⅛	Nat'l Car., pfd.....	124*	124*

BOSTON.

	Nov. 22.	Nov. 29.		Nov. 22.	Nov. 29.
Am. T. & T.....	142⅞	140¾	Mex. Tel.....	3*	3*
Cum. Tel.....	147*	147*	Mex. Tel., pfd.....	6*	6*
Edison E. Ill.....	251*	250*	N. E. Tel.....	135	134¾
Gen. Elec.....	162¼	161¼	W. T. & T.....	12	12
Mass. E. Ry.....	16*	16*	W. T. & T., pfd.....	90	89½
Mass. E. R., pfd....	80	80			

* Last price quoted.
Shares sold are for week of Nov. 22 to Nov. 27.

NORTH SHORE ELECTRIC COMPANY, CHICAGO.—At the annual stockholders' meeting of the North Shore Electric Company, of Chicago, Nov. 29, the report for the year ending Sept. 30, 1909, was presented showing gross earnings of $1,005,432, net earnings of $404,437 and a surplus after paying fixed charges of $214,083. Samuel Insull, president of the company, announced that to provide funds for the acquisition of additional electric light and power properties and for the construction of substations and the enlargement of the company's distribution system, necessitated by the growth of the company's business, an increase in the capital stock of $220,000 and in the outstanding first mortgage bonds of $285,000 had been made. The results of the operation of the new generating station at Waukegan have been very satisfactory and have enabled the company to secure contracts for the furnishing of additional power to interurban railways. There has been a substantial increase in the industrial power business during the year. On Sept. 30, 1909, the connected business of the company, exclusive of railway power business, amounted to the equivalent of 309,786 16-cp lamps. The corresponding figure in 1908 was 263,173 16-cp lamps. The company, which supplies electricity to the suburban villages and towns around Chicago, has five generating stations, located at Waukegan, Evanston, Maywood, Blue Island and Chicago Heights, Ill. There are also substations at Libertyville, LaGrange, Park Ridge, Lake Bluff, Harvey, Evanston (Clark Street) and Highland Park. Of the balance of $214,083 remaining from the net earnings of the year after bond interest had been paid, $75,600 was set aside for a special depreciation reserve, and $103,552 paid in dividends, leaving a balance of $34,930 carried to surplus, making the total surplus on Sept. 30, 1909, $154,000. The balance sheet shows total assets of $8,635,344. The liabilities include $4,000,000 in capital stock, $4,000,000 in bonds, and a depreciation reserve of $267,640.

BRISTOL (TENN.) GAS & ELECTRIC COMPANY.—The plant and franchise of the Bristol (Tenn.) Gas & Electric Company has been purchased by a New York syndicate, the name of which has not been made public. It is said that the price paid was about $400,000. The Bristol company has outstanding bonds to the amount of $325,000, and has in prospect a large water-power development near Bristol.

CONTINENTAL TELEPHONE & TELEGRAPH COMPANY.—It has been announced that the Continental Telephone & Telegraph Company, the new $50,000,000 concern organized to act as a holding company for the Independent telephone interests in the Central States, has purchased control of the American Union Telephone Company, with headquarters at Harrisburg, Pa. The American Union company was formed several years ago to take over the business of various Pennsylvania independent lines. It has an authorized capitalization of $25,000,000 and a bond authorization of the same amount. There have been issued $5,600,000 of stock and $11,000,000 of bonds. The Continental Company now practically controls the Independent telephone situation in Delaware, Maryland, New York, West Virginia, Virginia and New Jersey. Much of this territory was previously controlled by the Interstate Company, which was taken over by the Continental.

WISCONSIN ELECTRICAL PROPERTIES.—The street railway, light, and heat and power companies of Wisconsin show an increased valuation of nearly $3,000,000 compared with a year ago, and the taxes have been doubled by the final assessment of the State Board of Assessment. The sum of $422,015 will be paid in taxes by these companies. Fifteen per cent of the amount, or $62,302, will go to the State, and the remainder, or $358,712.89, will go to the towns, cities or villages where the properties taxed are located. The Milwaukee Electric Railway & Light Company will pay a tax of $249,763. The Southern Wisconsin Railway Company, operating in Madison, will pay $8,001, $6,801 of which will go to the City of Madison.

MACKAY COMPANIES DIVIDEND INCREASED.—Announcement was made last week that the quarterly dividend on the common stock of the Mackay companies would be increased from 1 per cent to 1¼ per cent, putting the stock upon a 5 per cent basis. The dividend on the preferred stock will continue at 4 per cent. The Mackay Companies is not an incorporated concern, although it has $41,380,000 of common stock. It is announced in the concern's literature that it is "a voluntary association created by agreement and declaration of trust." Clarence H. Mackay, president of the company, continues to assert that there is no thought of any merger with the Western Union or with the American Telephone & Telegraph Company.

CHICAGO SUBWAY COMPLICATIONS.—It is said that the managers of the Chicago Subway Company have decided not to pay the interest due Dec. 1 on the $17,000,000 of first lien bonds, and that the appointment of a receiver will be asked for. For some time the price of the stock of this company has indicated that this course would be adopted. It is known that Harriman and Armour interests have advanced about $8,000,000 for the payment of interest heretofore and for development work, but the earnings have never caught up with the fixed charges of the company, and until very recently have been insufficient to cover the cost of operation.

UNION SWITCH & SIGNAL COMPANY.—A semi-official statement from the Union Switch & Signal Company indicates that the company is enjoying the most prosperous period of its history. In addition to the very large order for equipping the Pennsylvania tunnels, the company has a number of important contracts under way. The factory at Swissvale, Pa., is now employing about 1600 men as compared with 700 at this time last year. The company has a capital of $2,500,000 and a surplus of about the same amount. The company has outstanding only $100,000 of bonds and has in cash in bank several times that amount.

METROPOLITAN STREET RAILWAY REORGANIZATION.—At a meeting of the joint committee on reorganization of the Metropolitan Street Railway Company last week, at which representatives of the various bondholders' committees were present, C. E. Tripp, connected with Stone & Webster, was elected chairman of the committee in place of the late John W. Castles. Mr. Tripp has for the past year been devoting himself exclusively to working out a plan of reorganization for the Metropolitan system.

NORFOLK & BRISTOL STREET RAILWAY COMPANY.—A petition has been filed with the Railway Commission of Massachusetts by the Norfolk & Bristol Railway Company asking permission to issue $50,000 additional first mortgage 5 per cent bonds. The proceeds of these bonds are to be used for making further additions and improvements to the property. They are a part of an issue of $200,000, which was previously authorized by the commission, and of which $150,000 has already been issued.

EAST CREEK ELECTRIC COMPANY.—Application has been made to the Public Service Commission of the Second District of New York, by the East Creek Electric Light & Power Company, of St. Johnsville, for permission to issue a mortgage on all its property for $2,000,000, and to increase its capital stock from $200,000 to $750,000. The money is to be used for extensions and improvements.

DIVIDENDS.

Mackay Companies, quarterly, common 1¼ per cent; preferred, 1 per cent, payable Jan. 3.

Massachusetts Electric Companies, preferred, semi-annual, 1¾ per cent, payable Jan. 1.

Norfolk Railway & Light Company, semi-annual, 2 per cent, payable Dec. 6.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, extra 1 per cent, payable Dec. 23.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company:					
October, 1909	$524,706	$306,999	$217,707	$107,207	$110,500
October, 1908	481,001	292,826	188,175	104,472	83,703
American Pneumatic Service Company:					
Six months ended Sept 30, 1909	.....	.....	222,227	120,409	101,817
Six months ended Sept. 30, 1908	.....	.....	131,320	105,748	25,571
Electric Light & Power Company, of Abington and Rockland, Mass.					
September, 1909	7,681	4,618	3,062	795	2,266
September, 1908	4,790	3,014	1,776	327	1,448
Jacksonville (Fla.) Electric Company:					
September, 1909	38,375	20,807	17,567	8,480	9,087
September, 1908	34,017	18,372	15,645	8,053	7,591
Lowell Electric Corporation:					
September, 1909	29,186	14,823	14,363	6,181	8,181
September, 1908	26,327	16,138	10,189	2,786	7,403
Michigan United Railways Company:					
Year ended April 30, 1909	1,021,128	568,157	452,971	305,891	152,747
Year ended April 30, 1908	942,003	521,728	420,275	262,726	158,876
Montreal Street Railway Company:					
October, 1909	354,007	178,734	175,272	27,079	148,192
October, 1908	328,608	168,124	160,484	27,480	133,004
New York City Interborough Railway Company:					
Year ended June 30, 1909	150,027	160,915	*10,888	98,810	*109,371
Year ended June 30, 1908	106,935	143,071	*36,136	90,000	*126,136
North Shore Electric Company, Chicago:					
Year ended Sept. 30, 1909	1,005,432	600,995	404,437	190,354	214,083
Year ended Sept. 30, 1908	815,550	533,618	281,932	159,282	122,650
Pensacola Electric Company:					
September, 1909	21,649	12,828	8,821	4,335	4,485
September, 1908	17,417	12,035	5,381	4,351	1,029
Philadelphia Company, of Pittsburgh:					
October, 1909	1,641,008	978,990	662,018	.....	.....
October, 1908	1,396,428	813,132	583,296	.....	.....
Toledo Railway & Light Company:					
October, 1909	239,374	129,719	109,655	75,615	34,285
October, 1908	218,074	119,982	98,092	71,953	26,326
Twin City Rapid Transit Company:					
October, 1909	596,962	277,174	319,787	140,251	179,537
October, 1908	554,166	265,892	288,273	138,667	149,606

* Deficit.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—It is reported that the Birmingham Railway, Light & Power Company will soon build an extension of its lines from Wylam, Ala., to the new plant of the Tennessee Coal, Iron & Railway Company.

GADSDEN, ALA.—The grading for the extension of the Alabama City, Gadsden & Atalla Railway Company's line has been completed near Gadsden, Ala. This railway will extend from Forest Avenue, Gadsden, to the new plant of the Southern Iron & Steel Company.

GURLEY, ALA.—The Gurley Light & Power Company is reported to have placed contracts for a greater part of the machinery for its proposed power plant. The company is in the market for a new or second-hand 100 to 125-hp boiler, complete with fittings. The main office of the company is located at Huntsville, Ala. F. A. Howe, Jr., is president and treasurer.

HAYWARDS, CAL.—D. U. Teffelmier, representing the United Power Company, has filed a petition with the Board of Trustees asking for a franchise for the erection and maintenance of transmission lines throughout the city. The company has already applied to the Board of Supervisors and to the Trustees of San Leandro for a franchise.

NAPA, CAL.—The Napa Gas & Electric Company is planning to extend its transmission line to the Napa Soda Springs. O. E. Clark, superintendent, will have charge of the work.

OAKLAND, CAL.—The citizens on Nov. 16 voted to issue $3,733,000 in bonds for municipal improvements, of which $80,000 will be used for the betterment of the fire, police and telegraph systems.

PASADENA, CAL.—The Southern California Edison Electric Company is planning to install meters throughout the city and will discontinue flat rates after Jan. 1, 1910.

SALINAS, CAL.—The Monterey County Gas & Electric Company has changed its two-phase, four-wire distributing system to a three-phase, three-wire, 60-cycle, 2200-volt system. F. J. Sutherland is general superintendent.

DENVER, COL.—Arrangements are being made by the Denver City Tramway Company for the installation of an additional 3000-hp unit in its plant at Fourteenth and Fifteenth streets and Platte River. An addition will be made to the power house, which will be large enough to accommodate several more units as needed.

DENVER, COL.—Plans are being prepared by the Colorado Telephone Company for enlarging and improving its telephone system in Denver, Col., in the States of Colorado and New Mexico during the coming year, which will involve an expenditure of $1,500,000. The work will include the opening of a new exchange and the erection of a new office building in Denver, and placing its wires in underground conduits. An entirely new plant will be built in Greeley, at a cost of $20,000; new systems and office buildings will be erected in a number of the larger towns in the State and new long-distance lines are to be added to existing circuits. A telephone line will be erected over the summit of Cumbres Mountain from Alamosa to Durango, and from Salida to Gunnison, a distance of over 200 miles. The system will also be extended into New Mexico.

GREELEY, COL.—Work has commenced on developing the falls of the Poudre Canon, located 12 miles above Zimmermans, to be utilized to generate electricity to drive the Poudre portal of the Laramie River tunnel for the Greeley-Poudre irrigation district. Most of the machinery for boring the tunnel is on the ground. A crib dam will be built above the falls and a 22-in. pipe line will extend from the dam to about three miles below the falls, where the tunnel entrance will be made. The water, which has a fall of 300 ft. in this distance, will be utilized to operate a turbine wheel which will generate about 400 hp, which will be used to operate compressed-air machinery for drilling and to light the camp and tunnel. The Laramie-Poudre Company, which is building this system, it is said, may take over the holdings of the Central Power Company in the Poudre Canon, which include the sites of the Roosevelt reservoir to be made in the canon by a large dam near Home, Colo. After the Poudre portal is well under way, work will begin on the Laramie River end of the 12,000-ft. tunnel, to conduct the water of the Laramie River into the Poudre. It is expected to complete the project in two years.

PUEBLO, COL.—Plans are being prepared by the Pueblo & San Luis Valley Electric Railway Company for the construction of an electric power plant to furnish electricity to operate its railway and to drive centrifugal pumps for both irrigation and drainage purposes. It is said that the company is considering the installation of gas engines to drive the plant.

COLCHESTER, CONN.—The citizens on Nov. 11 voted to appoint a committee to enter into a contract with the National Shoe Supply Company to furnish electricity for lighting the streets of the borough. Tungsten lamps of 32 cp will be used. Several residences and public buildings will be wired for electric lamps.

EAST HARTFORD, CONN.—Negotiations are under way between the East Hartford Fire District and the Hartford Electric Light Company for a new contract, under which the old street lighting system will be replaced with a new and up-to-date system. The new contract calls for 100-cp tungsten lamps on Main Street and Burnside Avenue, and 50-cp lamps on other streets. At present arc lamps are used on Main Street and series incandescent lamps on side streets.

NIANTIC, CONN.—The New London & East Lyme Street Railway Company is contemplating extending its electric lighting system through Main Street.

ROCKVILLE, CONN.—The stone mill of the J. J. Regan Manufacturing Company, which was recently acquired by Belding Brothers & Company, is being fitted up for the manufacture of silk thread. The changes include an enlargement of the power plant and installation of a turbine wheel, the erection of a new chimney and interior renovation.

NEW CASTLE, DEL.—The American Power Company has applied for a franchise to erect transmission lines from New Castle to Rogers' Corner, thence to Clarke's Corner, and from the last-named place to Delaware City for the distribution of electricity for lamps, heat and motors in Delaware City, Fort Du Pont and to residents along the road.

WASHINGTON, D. C. (TAKOMA SUBSTATION).—Bids will be received until Dec. 27 at the office of the constructing quartermaster, Washington, D. C., for the construction of an electric lighting system at Fort Washington, Md. Plans and specifications may be seen at the above office and also at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $10 will be required for each set of plans to insure safe return of same. Captain H. L. Pettus is constructing quartermaster.

LAKELAND, FLA.—At an election held Nov. 22 the citizens voted to issue $65,000 in bonds, the proceeds to be used for the construction of a new electric light plant and extensions to the water-works system.

MARIANNA, FLA.—It is reported that the proposition to issue $10,000 in bonds for consolidation and improvement of electric light plant and water works system will be submitted to a vote of the people.

SENOIA, GA.—W. B. Baggarly, H. L. Ware, A. O. Baggarly, J. A. McKnight and others are organizing a company in Senoia, Ga., to establish and operate an electric light plant and will at once petition the City Council for franchise.

VALDOSTA, GA.—It is stated that J. H. Dasher will construct a 10-mile telephone line, extending from Valdosta in the direction of Bemiss, connection to be made with the system of the Southern Bell Telephone & Telegraph Company.

WAYCROSS, GA.—The Waycross Gas, Electric & Railway Company has been granted a franchise by the City Council giving the company street railway, electric and gas privileges in Waycross. G. W. Deen, of Waycross, is president.

MONTPELIER, IDAHO.—The Bear Lake Power Company has recently placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for 26 transformers of various sizes.

SHELLEY, IDAHO—The Gem Light & Power Company has been granted a permit from the State to develop the water power of Snake River, two miles above Shelley, to generate electricity. The dam is under construction and will be 100 ft. high and 310 ft. long. The plant will cost about $100,000 and will have an output of about 8000 hp. It is expected to have the plant completed about Feb. 1, 1910.

CHICAGO, ILL.—The City Council has directed the finance committee to enter into negotiations with the Board of Trustees of the Sanitary District of Chicago with a view of securing electricity for lighting the streets of the city. It is proposed to install a complete lighting system in connection with the system of sanitary district, at a cost of approximately $2,000,000. The proposition as originally submitted to the city contemplated lighting only Hyde Park with electricity supplied by the Sanitary Board.

FARMER CITY, ILL.—The question of making improvements to the municipal electric light plant is under consideration. C. E. Conover is chief engineer.

LEROY, ILL.—The plant and holdings of the Leroy Electric Light, Power & Heating Company have been purchased by Wartena Brothers, of Hammond, Ind., for $15,000. It is said that the new owners will establish a day service and may later add a heating system.

DUNLAP, IND.—A mortgage has been placed on the property of the Osceola & Dunlap Telephone Company's plant for the purpose of securing funds for improvements and extensions to the system.

ELKHART, IND.—The Lake Shore Railroad is installing a large electric crane at its shops in Elkhart.

FORT WAYNE, IND.—The directors of the Fort Wayne & Wabash Valley Traction Company have decided to increase the output of its

plants in Huntington and Lafayette to relieve the local plant of part of its load. The company also proposes to erect large car barns at Lafayette and to enlarge the car barns in Huntington. The improvements contemplated will involve an expenditure of about $250,000. Col. J. Levering Jones is president of the company.

INDIANAPOLIS, IND.—The Merchants' Light & Heat Company have completed its conduit system into the State House preparatory to transmitting electricity from its new Washington Street power house. This company has secured the contract to light the building for two years. It is believed the next Legislature will provide for the installation of an electric plant to furnish electricity to light the State buildings and the State soldiers' monument.

KENDALVILLE, IND.—The Flint & Walling Manufacturing Company has recently placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for an additional electrical unit to meet the demands made on its plant. The equipment includes an 18-in. and 30-in. x 42-in. cross compound, heavy duty, non-condensing engine, operating at 150 lb. pressure, direct connected to a 500-kva, 480-volt, 60-cycle, 100 r.p.m. alternator, with exciter and switchboard.

LINTON, IND.—Judge C. E. Davis has refused to dissolve the temporary restraining order issued to prevent the City Council from disposing of the municipal light plant. It was decided that the Council had not complied with the law and consequently the sale could not be made at present. There were a number of bidders for the plant.

WABASH, IND.—Announcement has been made by William L. Moyer, who is promoting the Wabash & Northern Traction Company, that contracts have been awarded for all supplies, except the overhead work, for the proposed railway, which is to extend from Wabash to Warsaw, and that bonds to the amount of $1,000,000 have been provided, of which $250,000 will be available immediately.

GRINNELL, IOWA.—The Grinnell Electric & Heating Company, it is said, is contemplating the installation of an incandescent lighting system. H. M. Radford is proprietor.

IOWA CITY, IOWA.—Plans are being made by the Iowa City Electric Railway Company and the Rundell Land & Improvement Company for the construction of a railway four miles in length, which will connect the Rock Island station with the city park; Rundell's addition to Iowa City and other points. S. A. Swisher is president of the railway company.

OELWEIN, IOWA.—The Oelwein Light, Heat & Power Company is said to be contemplating the construction of a new generating station and the installation of additional machinery.

POCAHONTAS, IA.—An election will be held Dec. 7 to vote on the proposition to install a municipal electric light and power plant in Pocahontas, at a cost not to exceed $14,000.

STRAWBERRY POINT, IA.—The City Council is reported to be considering the installation of an electric light plant. F. Wood is superintendent of water works system.

AUGUSTA, KAN.—S. J. Safford and G. M. Smith have been granted a 20-year franchise by the City Council to construct and operate an electric light and power plant in Augusta.

COLBY, KAN.—Plans are being prepared by Burns & McDonnell, Scarrit Building, Kansas City, Mo., consulting engineers, for the construction of an electric light plant and water works system, in Colby, Kan., to cost about $45,000.

MARION, KAN.—Bids will be received at the office of the city clerk until Dec. 16 for furnishing material and labor for the construction of an electric lighting and water works system, separate bids to be submitted as follows: 1, For furnishing material and labor (except as separately outlined in this notice) and constructing a system of water works and electric lighting; 2, for furnishing material and labor and constructing power house and pump pit; 3, for furnishing hydrants and valves, f. o. b. cars Marion, Kan.; 4, for furnishing two 300-gal. per minute horizontal duplex compound pumps and two boiler-feed pumps, f. o. b. cars Marion, Kan.; 5, for furnishing material and erecting steel tower and tank, 120 ft. high, having a capacity of 70,000 gal.; 6, for furnishing material and erecting radial brick reinforced-concrete or steel chimney; 7, for furnishing two high-speed engines for 75-kw and 50-kw units, f. o. b. cars, Marion, Kan.; 8, for furnishing one 75- and one 50-kw generator and electrical equipment, f. o. b. cars Marion, Kan.; 9, for furnishing arc light equipment, f. o. b. cars, Marion, Kan. All of the above work to be furnished in accordance with plans and specifications on file at the office of the city clerk, Marion, Kan., and at the office of Burns & McDonnell, consulting engineers, Scarritt Building, Kansas City, Mo. Any one desiring extra copies may secure the same by a payment of $5 to cover cost of prints. Thomas W. Bown is city clerk.

OAKLEY, KAN.—The City Council has engaged Burns & McDonnell, consulting engineers, Scarritt Building, Kansas City, Mo., to prepare plans for an electric light plant and water works system for the City of Oakley, to cost about $35,000.

ONAGA, KAN.—The Onaga Light, Heat & Power Company, recently organized, has secured a 20-year franchise for an electric light plant and a contract for lighting the city for a term of five years. It is expected that the system will be in operation within 90 days. Contracts for a large part of the machinery have already been placed.

CADIZ, KY.—A. P. White & Company, of Cadiz, Ky., are contemplating the construction of a hydroelectric power plant, which will be equipped with internal combustion engines to be belted to engines during low water periods.

FRANKFORT, KY.—The contracts for the construction of the heating and lighting plant at the State Normal and Industrial Institute have been awarded as follows: Harry I. Wood & Company for lighting plant; the Marine Electric Company for outside lighting, and A. J. Anderson & Company for heating plant, all of Louisville, Ky.

FULTON, KY.—Preparations are being made to install an electric light plant in the Karmire Mill on the Tennessee side. The plant will furnish electricity for the mill and lumber yards. Most of the equipment for the plant has been purchased. J. W. Stitts, electrician, will have charge of installation of the plant.

LOUISVILLE, KY.—Mayor W. O. Head has vetoed the so-called Fetter lighting ordinance, which was sustained by both boards.

LOUISVILLE, KY.—G. D. Fetter, of the Fetter Printing Company, has been granted a permit to erect a power house in Louisville, at a cost of $27,000.

LOUISVILLE, KY.—The Snead Manufacturing & Building Company, recently organized, it is reported, will construct a large power plant for the purpose of supplying electricity to local industries.

PARIS, KY.—The Paris Electric Light Company is planning to make extensions to its electric light plant, which will include the installation of boilers, engines, generators, feed-water heaters, pumps, etc. S. L. Allen is purchasing agent and engineer in charge of the work.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company has purchased the franchise known as the Villere extension, which runs until 1956, and for which the company agrees to pay the city the sum of one-half of 1 per cent of the gross annual receipts. The line is to be double-tracked and begin at the intersection of Villere Street and Lafayette Avenue, extending through Lafayette to Franklin Avenue and St. James Avenue.

DOVER, MAINE.—The Dover & Foxcroft Light & Heat Company is installing a 150-hp boiler at its power station at East Dover, preparatory to the installation of a new 350-hp engine.

TAKOMA, MD.—The Baltimore & Washington Transit Company has been granted permission by the Town Council to extend its railway from the present terminus at the District line over and along Laurel Avenue in Takoma Park and to the south line of Carroll Avenue, to be completed within 90 days.

ANDOVER, MASS.—Preparations are being made by the Smith & Dove Manufacturing Company, of Andover, Mass., for the installation of an electric power plant, the equipment of which will include an engine-driven or steam turbine generating unit with a rating of 750 hp, with exciter, switchboard and alternating current generators.

EAST BRIDGEWATER, MASS.—James Brandley and Charles L. Nutting have been appointed a committee with the Selectmen to confer with the Edison Electric Illuminating Company, of Brockton, Mass., in regard to a new contract for lighting the streets of the town for a period of not more than three years.

FITCHBURG, MASS.—Preparations are being made by the Fitchburg & Leominster Street Railway Company for increasing the output of its power plant, which will include the installation of a 500-kw generator, a 1000-hp Cooper Corliss, cross-compound engine and Dillon boilers of 750 hp. The company originally planned to secure electricity from the Connecticut River Transmission Company, but has decided to enlarge its own plant.

HYDE PARK, MASS.—The Hyde Park Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue $21,750 in additional capital stock, the proceeds to be used to enlarge its property.

NEW BEDFORD, MASS.—The contract for electrical work in the New Nashawena Mills has been awarded to F. O. Plummer. The plant will be equipped with 5000-hp motors, ranging from 20 to 200-hp. About 5000 electric lamps will be required for the new mills.

TOPSFIELD, MASS.—The citizens have voted to light the streets and public buildings by electricity. The service will be furnished by the Beverly Gas & Electric Light Company, of Beverly, Mass., which already has its transmission lines extended to the town. The street lighting system will consist of 28 lamps.

CHESANING, MICH.—The Village Council is considering the question of purchasing water power rights with a view of developing the same to furnish power to operate the municipal electric light and water plants. The power house is located along the river within a few rods of the dam.

MENDON, MICH.—The City Council and Business Men's Association have decided to secure a 90-day option on the dam and water rights of the old Stafflet Mill at Parkville, five miles west of Mendon. If it is decided to purchase the property the city will construct an electric power plant and transmit electricity to Mendon for lighting the city and for commercial purposes.

PONTIAC, MICH.—The Detroit Edison Company has asked for permission to build a substation in the central portion of the business district, to cost $20,000.

BARNESVILLE, MINN.—Bids will be received by M. P. Philippi, city clerk, until Dec. 3 for a 110 to 125-hp compound automatic condensing engine; one 75-kw, 250-volt generator, and one panel switchboard.

BRAINERD, MINN.—Arrangements are being made by the Northwestern Telephone Company for rebuilding its local system, which will involve an expenditure of about $40,000. The work will include the erection of 60,000 ft. of aerial cable and the installation of a common battery system. J. W. Howatt, of St. Cloud, Minn., is district manager.

FARIBAULT, MINN.—The City Council has brought action against the Polar Electric Company to annul an 18-year lighting contract. For the past year the company has been giving an unsatisfactory service and the Council has refused to pay the company for it.

MINNEAPOLIS, MINN.—The Great Northern Development Company is reported to have located a site for its dam in connection with its proposed electric power plant on Government Lot No. 5, one mile above the mouth of Coon Creek and two miles below Champlin.

CHILLICOTHE, MO.—The Livingston County Mutual Telephone Company has petitioned the City Council for a franchise to install a telephone system in Chillicothe.

COLUMBIA, MO.—Plans are being considered for extensions to the municipal electric light plant and water works system. As soon as plans are prepared an election will be held to vote on the proposition to issue bonds to pay for improvements. John S. Bicknell is city clerk.

KANSAS CITY, MO.—The Toltec Portland Cement Company has placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for induction motors and equipment for its plant at Hidalgo, Mex., as follows: Five 150-hp motors of special design for driving tube mills; two 150-hp motors to be belted to line shafts; two 110-hp motors for pulverizers; three smaller belted motors, and one complete 20-hp single drum hoist.

MARYVILLE, MO.—Arrangements are being made to enlarge the power plant of the Maryville Electric Light & Power Company in the near future to enable it to meet the increased demands made upon it. A new 200-hp engine has been purchased and will soon be installed; the old boilers will be replaced with new ones of greater steam capacity.

PILOT GROVE, MO.—Plans are being considered by the Enterprise Telephone Company for improvements to its system, which will involve an expenditure of about $10,000. Harrison Simpson is manager.

SPRINGFIELD, MO.—Preparations are being made by the Springfield Gas & Electric Company to extend its service to surrounding districts. The company proposes to erect power houses and gas producer plants in a number of cities where franchises have been secured, which probably will ultimately be converted into substations supplied from a large central generating power plant.

TARKIO, MO.—The City Council is reported to be considering the installation of an electric lighting system.

BOZEMAN, MONT.—The Interstate Consolidated Telephone Company is reported to have acquired the long-distance telephone lines of the Haley Telephone Company.

CONRAD, MONT.—Plans are being prepared by C. T. Sacker and C. D. Flaherty, engineers of Livingston, Mont., for an electric light and water works system.

FORSYTH, MONT.—Plans are being considered for extensive improvements to the local telephone system, including the installation of a new switchboard.

LAUREL, MONT.—Application has been made to the City Council by the Eastern Montana Electric Railway Company for a franchise for an electric railway in Laurel. The company proposes to construct an interurban railway from Laurel to Billings, and to extend a line west from Laurel to Red Lodge, crossing the hill to Bear Creek, returning to Laurel by a loop which will embrace the entire Clark Fork Valley. George H. Kessethuth, of Billings, Mont., is interested in the project.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company has petitioned the City Council for a franchise over certain streets in the city. The interurban railway has been using the tracks of the old Citizens' line for an entrance into Lincoln. The contract will expire next August and the company has been notified that it will be expected to find another entrance into the city. The company proposes to tap the business district and to encircle the downtown section by a loop.

GOLDFIELD, NEV.—The New Bonnie Clare Mining Company has entered into a contract with the Nevada-California Power Company for electricity to operate its mill at Bonnie Clare. The transmission line will be extended at once.

CONCORD, N. H.—At the annual meeting of the board of directors of the Concord & Montreal Railroad Company the directors voted to authorize the president to petition the State Railroad Commissioners for permission to sell 2500 shares of its stock, the proceeds to be used to pay for and improve the electric light plant recently acquired in Franklin.

JERSEY CITY, N. J.—The Atlantic & Pacific Telephone & Telegraph Company has filed an amendment to its charter increasing its authorized capital stock from $25,000 to $250,000. Edward P. Meany is president of the company and Richard J. Morgan, secretary.

MORRISTOWN, N. J.—The Morris County Traction Company expects soon to place contracts for the construction of five miles of single track. G. C. Gochnauer is president of the Morris County Construction Company.

ORANGE, N. J.—The Common Council has awarded the contract for construction of the municipal electric light plant and system to Storms & Company, of Newark, N. J., for $82,939. The contract does not provide for an underground distributing system on Main Street.

EAST CREEK, N. Y.—The East Creek Electric Light & Power Company has applied to the Public Service Commission for permission to issue a mortgage on all the property for $3,000,000 and to increase its capital stock from $200,000 to $750,000.

HORNELL, N. Y.—The Hornell-Bath Interurban Railway Company has applied to the Public Service Commission, Second District, for permission to construct an electric railway from Hornell to Bath, 23 miles in length, passing through the towns of Hornellsville, Fremont, Howard, Avoca and Bath. The company has also asked for authority to issue its common stock to the amount of $250,000 and bonds to the amount of $500,000. The company is capitalized at $250,000.

JAMESTOWN, N. Y.—At an election held Nov. 20 the citizens defeated the proposition to purchase the electric plant of the Jamestown Lighting & Power Company and consolidate it with the municipal electric light plant. It was proposed to issue $90,000 to purchase the plant and to appropriate $30,000 for consolidating it under one roof with the municipal plant.

LITTLE FALLS, N. Y.—Arrangements are being made by the Syenite-Trap Rock Company for the installation of a new stone-crushing plant to replace the plant recently destroyed by fire. The entire plant will be operated by electricity. John Thomlinson is superintendent.

MIDDLEPORT, N. Y.—The Niagara Falls Transmission Company has been granted a franchise by the village authorities to cross the streets of Middleport. The company is preparing to extend its transmission lines.

MINEVILLE, N. Y.—The Mineville Light, Heat & Power Company is contemplating the construction of an electric generating station to furnish electricity in Mineville and surrounding districts.

NEW YORK, N. Y.—The Second Avenue Railroad Company has applied to the Public Service Commission for permission to equip that portion of its line running through Worth Street from Chatham Square to Broadway to be operated by electricity. The receiver has already been authorized by the courts to equip the tracks for electrical operation.

PORT CHESTER, N. Y.—The Board of Trade has applied to the Public Service Commission for a reduction of rates for both gas and electric service. The citizens ask for gas at $1.10 per 1000 cu. ft. and electricity at 10 cents per kw-hour. The present rates are 15 cents per kw-hour for electricity and $1.40 per 1000 cu. ft. for gas. The petition of the board include Port Chester, Rye, Harrison and Mamaroneck. The service is furnished by the Westchester Lighting Company. The White Plains Board of Trade has also petitioned for a reduction of rates in its section, which is served by the same company.

WILLARD, N. Y.—The contract for the installation of an engine and generator in the Willard State Hospital was awarded to George Sykes, of New York, N. Y., for $3,440.

FRANKLIN, N. C.—Preparations are being made by Henry O. Cozad for the construction of an electric light plant. A dam is now being built across Cartoogechaye Creek to develop from 200 to 300 hp.

AMBROSE, N. D.—Application has been made to the City Council by A. Engstrand for a 10-year franchise to construct and operate an electric light plant in Ambrose.

CASSELTON, N. D.—The construction of an electric light plant in Casselton is under consideration by Minneapolis capitalists.

CROSBY, N. D.—Minneapolis capitalists are reported to be considering the installation of an electric light plant in Crosby.

HETTINGER, N. D.—It is reported that C. A. Meyer, of Clarkfield, Minn., is contemplating the installation of an electric light plant in Hettinger.

MANDAN, N. D.—The North Dakota Independent Company contemplates the erection of 214 miles of telephone lines, which will involve an expenditure of $50,000.

SHERWOOD, N. D.—A company has been organized by the farmers of Winlay, Elmor's and Workman townships, all in Canada, for the purpose of erecting 57 miles of telephone line to connect with the central office in Sherwood.

COLUMBUS, OHIO.—Plans submitted by Samuel Hannaford, architect to Safety Director Small, for the heating and electrical work and for boilers for the power plant of the contagious group of the new city hospital in Burnett Avenue have been approved, and bids for installing the power plant will be called for soon. The plant will furnish electricity for lamps and motors and heat for the entire group of buildings at the hospital.

COSHOCTON, OHIO.—Preparations are being made by the Coshocton Light & Heat Company for the installation of two new generating units, having a combined rating of 1200 hp, together with equipment for auxiliary power plant.

LIMA, OHIO—Announcement has been made by the officials of the Schoepf electric lines that the Lima-Defiance steam railroad will be equipped to be operated by electricity at once. The railway is about 40 miles in length.

NEWARK, OHIO.—The Scott Chair Manufacturing Company is reported to be considering the purchase of a gas producer engine and other equipment in the near future.

NEW KNOXVILLE, OHIO—The Village Council is reported to be negotiating with the Western Ohio Traction Company regarding the installation of an electric lighting system in New Knoxville.

WARREN, OHIO—The capital stock of the Warren & Niles Telephone Company has been increased from $100,000 to $200,000. The company

will the first of the year remove its plant to the Henderson property, recently purchased. A new switchboard will be installed.

WESTERVILLE, OHIO—The City Council is considering an ordinance granting the Municipal Utilities Company, of Columbus, Ohio, a 25-year franchise to construct and operate an electric light and water plant, to cost $23,500.

CHICKASHA, OKLA.—The Oklahoma Cotton Mills Company has purchased equipment for its plant, which will soon be completed, for the manufacture of knit underwear. The machinery will be driven by electricity. A boiler and engine will be installed for use in emergencies.

ERICK, OKLA.—It is reported that electrical equipment will be purchased for the municipal electric plant in Erick about Jan. 1. A bond issue was recently authorized for the installation of the plant.

JENNINGS, OKLA.—The Jennings Electric Light & Power Company, it is said, will purchase machinery for its plant immediately. J. H. Rickard is engineer.

LINDSAY, OKLA.—The municipal electric light plant and water works system has been completed at a cost of $40,000.

MUSKOGEE, OKLA.—Preparations are being made by H. M. Byllesby & Company, who control the Muskogee Gas & Electric Company, for the construction of a large dam on the Grand River. The company has purchased large tracts of land in the Grand River valley above the proposed power site. The Muskogee Gas & Electric Company has applied to the City Council for a new franchise with a long term contract for street lighting. Dennis T. Murphy, of Oklahoma City, is president of the Muskogee company.

NOWATA, OKLA.—The Coffeyville-Nowata Railway & Power Company is planning to commence work on its proposed electric railway by Jan. 1. The road will be 23 miles in length and will extend from Nowata, Delaware, Lenatah, South Coffeyville, Okla., and Coffeyville, Kan. The company proposes to furnish electricity to the cities along the route. The capital stock is placed at $200,000. W. V. Thraves is president and general manager and E. P. Hannaford, of Nowata, chief engineer.

OKLAHOMA CITY, OKLA.—Contracts have been awarded for grading and bridge work by the Oklahoma Railway Company for the construction of its proposed new interurban railway between Capitol Hill and Moore, seven miles south of Oklahoma City. It is expected to have the line completed and in operation by June 1, 1910. John W. Shartel is vice-president of the company.

WESTVILLE, OKLA.—The Westville Electric Light & Power Company is considering the question of installing an engine or small turbine during the winter.

BENTLEYVILLE, PA.—The Bentleyville Electric Light & Power Company, recently organized, is preparing to install an electric light plant, work on which will commence before the end of the year. The officers of the company are: Charles F. Fisher, of Pittsburgh, president, and E. E. French, of Ellsworth, secretary.

PORTLAND, ORE.—The Portland Railway, Light & Power Company, it is said, will require an additional hydroelectric unit for its Cazadero station to furnish electricity for its proposed new extensions and increasing commercial load.

CANONSBURG, PA.—The South Canonsburg Council has granted the National Telephone Company a 25-year right-of-way franchise, in return for which the company is to pay the city $1,000 and a 50-cent pole tax. T. B. Lee is district manager.

CRUM LYNNE, PA.—The Vulcan Charcoal Iron & Steel Company is reported to be in the market for an electric power and lighting unit with an output of about 50 kw; also a three-motor electric traveling crane with a capacity of from 25 to 30 tons, 27 to 35 ft. span.

EAST GREENVILLE, PA.—The Town Council has granted a franchise to a Wyoming, Pa., syndicate to erect an electric light plant within the borough.

HARRISBURG, PA.—The control of virtually all the independent telephone lines in Pennsylvania outside of Philadelphia and Allegheny counties has passed into the hands of the Continental Telephone & Telegraph Company, of New York, N. Y., with the purchase of the American Union Telephone Company, with headquarters at Harrisburg, Pa., which was formed about two years ago for the purpose of continuing the independent telephone lines in Pennsylvania. The Continental Company controls the independent lines in New York, New Jersey, Maryland, Delaware, Virginia and West Virginia, and recently took over the Inter-State Telephone Company of New Jersey.

HUNTINGDON, PA.—The stockholders of the Huntingdon Valley Light & Power Company have called a special meeting to be held Jan. 18 to vote on the proposition to purchase the franchises and other property of the Hatboro Electric Light Company, of Hatboro, Pa., and the Wissahickon Electric Company. The Huntingdon Valley company has already been taken over by the American Gas Company, together with other suburban lighting properties.

MILTON, PA.—The Milton Electric Light & Power Company, which was owned by the Railway Company General, has been sold to Philadelphia capitalists who, it is said, will build a new power plant and reconstruct the entire system.

PHILADELPHIA, PA.—The Lehigh Coal & Navigation Company is reported to be contemplating the erection of an electric power plant on is property near Nesquehoning, Pa., plans for which have not yet been completed. Rollin H. Wilbur is vice-president.

PHILADELPHIA, PA.—The Philadelphia & Suburban Railroad Company has filed an application at Harrisburg for a charter to construct a subway on Broad Street north of the City Hall to a point near Cumberland Street. The new plans provide for an extension of the proposed subway system by elevated roads to Fairmont Park, Frankford and Wayne Junction.

SCRANTON, PA.—Announcement has been made that the Scranton Electric Company contemplates extensive improvements to its plant, including the construction of a large central power plant, which will involve an expenditure of about $500,000.

STEELTON, PA.—The Allis-Chalmers Company, Milwaukee, Wis., has secured a contract from the Pennsylvania Steel Company for a twin tandem, gas-driven blowing engine.

WOONSOCKET, R. I.—The Desurmont Worsted Company is reported to be contemplating the installation of a steam turbine power plant next May to furnish electricity to operate its proposed new mill.

ANDERSON, S. C.—It is reported that the Duke interests, which recently purchased control of the Anderson Traction Company, will make extension to the railway, connecting with the Seaboard Air Line Railroad. It is said that the interurban railway will be extended to Spartanburg, S. C., and Greensboro, N. C., northward and to Abbeville or Greenwood on the east. It is also announced that the railway will handle freight as well as passenger traffic.

BEAUFORT, S. C.—Captain C. C. Townsend has applied to the Town Council for a franchise to erect and operate a telephone system in Beaufort. If the franchise is granted a long-distance service will be established.

LANCASTER, S. C.—Contracts have been awarded for material and equipment required for the construction of an electric light plant in Lancaster. The General Electric Company will furnish all the electrical apparatus. Electricity for operating the system will be furnished by the Southern Power Company. It is expected to have the plant completed in about 30 days. Col. Leroy Springs is interested in the project.

BRIDGEWATER, S. D.—The City Council has granted A. Y. Weidenbach, of Bridgewater, a 25-year franchise to construct and operate an electric light plant in this city. A contract has been awarded for construction of the power house.

HOWARD, S. D.—C. A. Laurson is reported interested in a project to establish an electric light plant in Howard. A company will be organized to operate the plant.

RAPID CITY, S. D.—Bids are asked for the installation of a telephone system by the Black Hills Independent Telephone Company.

RAPID CITY, S. D.—Arrangements are being made by the Black Hills Independent Telephone Company for the construction of its telephone system in this city, contracts for which will be awarded in the near future. The company is capitalized at $50,000.

ROMANO, S. D.—The Citizens Light & Power Company is reported to have awarded a contract to H. P. Mortesen, of Toronto, S. D., for the installation of an electric light plant for $2,000.

TYNDALL, S. D.—Plans are being considered for the construction of a municipal electric light plant, to cost from $16,000 to $18,000. C. H. Stanfield, of Yankton, S. D., is consulting engineer. J. J. Maus is city recorder.

BRISTOL, TENN.—The plant and holdings of the Bristol Gas & Electric Company have been purchased by a New York syndicate for $400,000. The company has outstanding bonds to the amount of $325,000 to cover the cost of a large water power development near Bristol.

JOHNSON CITY, TENN.—Plans are being considered by the Watauga Electric Company for enlarging its electric plant. As yet plans have not been decided upon.

STANTON, TENN.—It is reported that an electric light plant will be installed in Stanton. G. N. Albright is interested in the project.

WINCHESTER, TENN.—It is reported that Miller Brothers are contemplating the installation ot an electric power plant in connection with their proposed new factory.

BELLVILLE, TEX.—D. Wilrodt is reported to be interested in the establishment of an electric light and ice plant and creamery.

CHILDRESS, TEX.—Preparations are being made by the Fort Worth & Denver City Railroad Company for enlarging its power plant, which will include the installation of an engine, generator and four boilers. An addition will also be made to the power house.

CLARENDON, TEX.—The Clarendon Water, Light & Power Company, it is said, contemplates making improvements to its system in this city.

DALLAS, TEX.—Arrangements are being made for forming an association for the construction of an interurban railway to extend from Dallas to Terrell. W. H. Gaston, R. H. Stewart and Alexander Sanger, of Dallas, Tex.; Thomas Layden, of Forney, and W. P. Allen, of Terrell, have been appointed as trustees of the association.

HOUSTON, TEX.—Bids will be received by Harris County until Dec. 8 for electric fixtures for courthouse, plans for which may be obtained from Lang & Witchell, architects, Dallas, Tex. The amount to be expended is $15,000. A. E. Amerman, of Houston, Tex., is county judge.

LUBBOCK, TEX.—The Lubbock Light, Power & Ice Company is contemplating increasing its power-plant machinery and refrigerating apparatus.

UVALDE, TEX.—The Uvalde Street Railway Company is preparing to build an extension of its railway from Uvalde to Batesville, a distance of 30 miles. Gasoline motor cars will be used.

SALT LAKE CITY, UTAH.—The County Commissioners have granted the Salt Lake & Los Angeles Railway Company a franchise to double-track and equip its railway to be operated by electricity from Salt Lake City to Salt Air. The commissioners have also granted the amended franchise of the Telluride Power Company for the construction of its transmission lines upon the highways of the county.

BRISTOL, VA.—Preparations are being made by the Cumberland Telephone Company for the construction of a long-distance telephone line from Bristol through the coal fields of Southfield, Va., for which an appropriation has already been made. An additional copper line will be erected from Knoxville to Bristol, a distance of 130 miles, which will be followed by the rebuilding of the line between Bristol and Gate City, Va., and the erection of a line from Gate City to points in Wise and Lee counties. Leland Hume is manager.

COLONIAL BEACH, VA.—The Municipal Council has granted John G. Capers, Evans Building, Washington, D. C., a franchise to construct an electric railway from Colonial Beach to Quantico, a distance of 22 miles.

RICHMOND, VA.—Bids will be received at the office of E. E. Davis, superintendent of Water Department, City Hall, Richmond, Va., until Dec. 14 for construction of electrical transmission lines, plans and specifications for which are on file in the above office.

RICHMOND, VA.—The finance committee has recommended to the Council a supplemental appropriation of $65,000 for the construction of the distributing system in connection with the proposed new electric light plant. This appropriation is in addition to the recent bond issue of $350,000 provided for the erection of the plant and for the installation of water pumps at the new pump house, making the total appropriation for the plant and water pumps to date $415,000.

BAKER, WASH.—The Baker River Power & Light Company has filed notice of appropriation of water rights of the Baker River to the extent of 2000 cu. ft. per second. The company proposes to erect a power station in or near Concrete and supply electricity to the villages along Baker River.

BELLINGHAM, WASH.—A proposition has been submitted to the citizens of Bellingham by L. H. Bean, local manager of the Whatcom County Railway & Light Company, and R. T. Laffin, district manager of Puget Sound, in behalf of the Stone & Webster interests, assuring the construction of Bellingham-Skagit County Interurban Railway immediately by Stone & Webster, provided that the citizens of Whatcom and Skagit counties raise $400,000 of the $1,500,000, the estimated cost of the proposed railway. In consideration of the $400,000 raised preferred cumulative stock of the Whatcom Railway & Light Company will be issued. The road will be about 30 miles in length and will connect Bellingham, Burlington, Mount Vernon and Sedro Woolley.

LEAVENWORTH, WASH.—Plans are being prepared by the Great Northern Railroad Company for the construction of a large electric power plant in the Lake Chelan country, which will develop about 80,000 hp in connection with equipping the western division of the railroad to be operated by electricity. The proposed plant is to be supplemented by the present Leavenworth station, which has an output of 12,000 hp, which is utilized for hauling trains through the Cascade Mountain tunnel. The company has been working on the proposition for some time, locations having been made several years ago by Everett McChesney, of Everett, and others.

PASCO, WASH.—The County Commissioners have granted N. G. Blalock, representing the Walla Walla & Columbia Traction Company, a franchise to enter Franklin County with an electric railway.

SPOKANE, WASH.—Plans are being considered by the lamppost committee of the Chamber of Commerce for removing all arc lamps in the district bounded by Front and First Avenues and Bernard and Cedar streets, to be replaced by 558 cluster lamps. The Washington Water Power Company has submitted a proposition to furnish 180 cp to each post and to maintain the lamps and globes for $50 per year. The committee proposes to have the property owners in the district pay for the installation of the lamps and the city maintain them.

WALLA WALLA, WASH.—The factory of the Washington Weeder Works, which was destroyed by fire last September, has been rebuilt and is ready for the installation of new machinery. The new buildings are twice the size of those burned, and all machinery installed will be operated by electricity instead of by gasoline engines as before.

NEW MARTINSVILLE, W. VA.—The New Martinsville Electric Light, Heat & Power Company has been granted a franchise to furnish electricity for lamps in Brooklyn. It is expected to have the service ready by Jan. 1, 1910.

WHEELING, W. VA.—The Rapid Transit Railway Company has applied to the Board of County Commissioners of Ohio County for a franchise to construct an electric railway on certain streets and highways in the county.

APPLETON, WIS.—A. D. Barnes, vice-president of the Chicago & Wisconsin Valley Railroad Company, has submitted a proposition to the business men of Appleton and Outagamie Counties for the construction of an interurban railway from Appleton northward through Hortonville, New London, Waupaca and to Hancock, where the proposed railway will connect with line of the Chicago & Wisconsin Valley Railroad Company, which expects to have an interurban road in operation from Stevens Point to Chicago before September, 1911.

MILWAUKEE, WIS.—It is understood that a number of improvements will be made to the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railroad, which will include the installation of electric motor-driven machinery in some departments of the plant.

MILWAUKEE, WIS.—Judge Turner in a decision handed down Nov. 20, refused to dissolve the injunction obtained by J. T. Neacy restraining the city from issuing bonds for the construction of a municipal electric light plant. An immediate appeal will be made to the Supreme Court and if the decision is sustained the proposition to issue bonds will have to be submitted to the people again. The erection of the municipal electric plant will be delayed for at least another year.

LACOMBE, ALTA., CAN.—The Council has awarded contracts for an auxiliary steam plant for the power house and for the repairs to the dam, to cost about $4,000. The Waterous Engine Works Company, of Brantford, Ont., has the contract for steam plant and Councillor Mobley will supervise repairs to the dam.

REVELSTOKE, B. C., CAN.—The contract for the construction of the municipal electric light plant (bids for which were opened Nov. 17) was awarded to the Canadian General Electric Company, Toronto, Ont., Can. Bruce A. Lawson is city clerk.

WINNEPEG, MAN., CAN.—Owing to the bursting of a penstock at the hydroelectric power plant at Lac Du Bonnet, which flooded the generating station, the electric lighting and street car service in Winnepeg has been badly crippled. The steam power plant is supplying power to the extent of 1000 hp and the Canadian Pacific Railway about the same amount, but this is not sufficient to supply more than a partial and intermittant street car service.

BRIDGEBURG, ONT., CAN.—The Village Council has decided not to present a by-law to the ratepayers asking for a franchise for the Canadian Niagara Power Company. The Council will not agree to the present conditions of the franchise. The company asks for a 25-year franchise and makes the price for arc lamps $60 each per year and $20 per lamp per year for incandescent lamps. The Council is not willing to grant a franchise for more than 20 years and will not pay more than $50 per lamp per year for arc lamps and not more than $12.50 each for incandescent lamps.

BROCKVILLE, ONT., CAN.—The municipal light and power department closed its fiscal year on Sept. 30, and the report shows receipts amounting to $51,915. The operating expenses were $43,453, and $7,597 was paid on debentures, leaving a balance of $864. This plant was purchased nine years ago and has since made substantial reductions in the prices of gas and electricity.

EASTVIEW, ONT., CAN.—The Village Council is reported to be in favor of installing a municipal electric light plant to supply electricity to the entire village at the rate of $15 per hp per year.

KINGSTON, ONT., CAN.—The Kingston Street Railway Company has stopped the operation of its cars until it can come to an understanding with the city as to the length of time the contract for electrical power will be granted. According to its franchise the company can cease operation for six months without affecting its franchise.

LONDON, ONT., CAN.—The London Electric Light Company has notified the city that its contract for lighting the streets expires on Nov. 30, and that it will be necessary to make a new contract if the service is to be continued. The company has offered to renew the contract for another year, pending the completion of the city's distributing plant, to light the streets with Niagara power at the rate of 23 cents per lamp per night; but if a contract for a shorter period is desired the company states that a sliding scale of rates must be charged. There are now 342 street lamps in use. The hydroelectric power is promised and expected to be ready for delivery in London early in the spring. A special meeting of the Council will soon be held to consider the question. The amount paid to the London Electric Company for street lighting for last year amounted to $28,146.

PETERBOROUGH, ONT., CAN.—Word has been received from Ottawa that provision has been made in the estimates submitted to Parliament for the electric lighting of the Trent Canal between Peterborough and Lakefield.

WOODSTOCK, ONT., CAN.—The Water and Light Commissioners have awarded the Canadian General Electric Company the contract for supplying the necessary electrical equipment in order that the city may make use of Niagara power under its contract with the Hydro Electric Power Commission. The equipment will include a 5-panel switchboard, with instruments and regulators; three 300-kw transformers; two 1500-gal. per minute turbine pumps, each driven by a 175-hp induction motor, and one 500-hp motor to drive the present generator. The amount of the contract is $20,000.

MONTREAL, QUE., CAN.—The Canadian Pacific Railway Company is considering the question of equipping its Windsor Street terminal for electrical operation, which will probably be extended to Montreal Junction.

MONTREAL, QUE., CAN.—The Canadian Light & Power Company has let contracts for three 500-kw, 2300-volt generators and transformers

to the Allis-Chalmers, Bullock Company, Ltd. The contract for switchboard was awarded to the Canadian Westinghouse Company.

SAN CRISTOBAL, L. C., MEX.—Messrs. Allen & Calves, of Comitan, Chiapas, Mex., have leased for a term of years the electric light plants of Francisco Orozco y Jimenez and of Paniagua y Garcia, of San Cristobal.

New Industrial Companies.

THE AERIAL DEMONSTRATION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture cars, vehicles, flying machines, etc. The incorporators are: J. J. Harper, E. J. Forhan and C. F. Martin, all of New York, N. Y.

THE CANADIAN CONSTRUCTION COMPANY, of Lawrence, Mass., has been chartered with a capital stock of $10,000 for the purpose of doing general construction work by William H. Molson, of Boston, Mass.; Joseph A. Clotier, Elzear Thibault and William H. Molson, all of Lawrence, Mass.

THE CHAMPION IGNITER COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 to handle a patent method of igniting. The officers of the company are: H. D. Eminger, of Foxboro, Mass., president; G. M. Faulkner, of Brookline, Mass., treasurer.

THE CHARTER ELECTRIC COMPANY, of Chicago, Ill., has been incorporated by George C. Cummings, John A. Dick and Archibald Wray, all of Chicago, Ill. The company proposes to manufacture and sell electrical appliances.

THE COLONIAL ENGINEERING & CONTRACTING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $50,000 by J. R. Taft, of New York, N. Y.; N. B. L. Secord, of Grantwood, N. J., and J. S. Frazer, of Brooklyn, N. Y. The company proposes to do a contracting and engineering business; also to deal in engineering and building supplies.

THE CONTINENTAL RAILWAY EQUIPMENT COMPANY, of Wilmington, Del., has filed articles of incorporation with a capital stock of $500,000. The incorporators are: P. A. Neuffer, R. M. Cole and H. M. Phillips, all of Chicago, Ill.

THE ELECTRO INSULATION COMPANY, of Chester, Pa., has made application for a charter at Harrisburg, Pa., for the purpose of manufacturing and selling machinery, electric supplies, equipment and insulation. The incorporators are: John Higley, William W. Hoy, Michael J. Byrnes, Thomas F. Ryan, Michael Shapiro, Daniel J. Rowan and E. L. Brooks.

THE FORBERG-CARLSON MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 by Charles A. Forberg, Otto B. Carlson and Frederick B. Roos, all of Chicago, Ill. The company proposes to manufacture machinery.

THE HEALEY ENGINEERING COMPANY, of Chicago, Ill., has been chartered by Robert F. Pettibone, John C. Burchard and Harold S. Osborne, all of Chicago, Ill. The company is capitalized at $50,000 and proposes to do a general construction and engineering business.

THE A. HOUSTON COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 to carry on an electrical and mechanical engineering business, machinists, etc. The incorporators are: Alexander Houston, M. A. Houston, of Jersey City, N. J., and John H. Spear, of Paterson, N. J.

THE HYDRAULIC PROPERTIES COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of constructing dams, buildings, etc. The incorporators are: F. M. Hoadley, H. L. Seigler, of New York, N. Y., and W. D. Johnson, of Hartford, Conn.

THE INVENTORS' MANUFACTURING COMPANY, of Wilmington, Del., has been chartered with a capital stock of $200,000 for the purpose of buying and selling patents. The incorporators are: J. L. Callam, F. Bayer and R. A. Manery, of Jacksonville, Fla.

THE H. P. KEANE COMPANY, of Atlanta, Ga., has been chartered with a capital stock of $10,000 by H. P. Keane and J. J. Batterman. The company proposes to deal in electrical apparatus, illuminating supplies and to do an illuminating and electrical engineering business.

THE LEARY CENTRIFUGAL MUFFLER & EXHAUST COMPANY, of Portland, Maine, has filed articles of incorporation with a capital stock of $500,000 for the purpose of manufacturing and selling engines. C. E. Eaton is president and T. L. Croteau, treasurer, both of Portland, Maine.

THE LEWELL MANUFACTURING COMPANY, of Chicago, Ill., has been chartered with a capital stock of $30,000 by George E. Chamberlain, C. Eugene Gilman and A. John Ehhenberger, all of Chicago, Ill. The purpose of the company is to design, manufacture and sell machinery.

THE LUCIOS ENGINEERING COMPANY, of Camden, N. J., has been incorporated by V. A. Murray, R. G. Elliott and Archworth Martin, all of Camden, N. J. The company proposes to do a general engineering, contracting and construction business.

THE McCORMICK COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $150,000 by C. W. Comfort, J. J. Morian and W. D. Steever, of Philadelphia, Pa. The purpose of the company is to do a contracting and engineering business.

THE MONARCH AUTOMATIC MACHINE COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $150,000 by William J. Collins, David H. Crown and William Brady, all of Brooklyn, N. Y. The company proposes to manufacture machinery, etc.

THE MONARCH ELECTRIC COMPANY, of Kansas City, Mo., has been incorporated by K. L. Day, E. P. Day, P. B. Chaney and others. The company is capitalized at $75,000 and proposes to deal in electrical supplies.

THE NORTH AMERICAN WIRELESS CORPORATION, of Portland, Me., has been incorporated with a capital stock of $10,000,000 to deal in all systems of wireless telegraphy. The incorporators are: C. E. Eaton, T. L. Coteau and J. E. Manter, all of Portland, Me.

THE OKLAHOMA GAS ENGINE COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $30,000. The company proposes to manufacture gas engines from 2 to 16 hp.. Arthur Fishbeck is president and manager; W. H. Clark, vice-president; George W. Lowe, secretary and treasurer, and James Worthington, superintendent.

THE OTTOMAN-ANGLO-AMERICAN COMPANY, of Jersey City, N. J., has been incorporated by P. F. Cook, D. Herr and W. G. Muirheld, of Jersey City. The company is capitalized at $12,000 and proposes to do a general mechanical engineering business, etc.

THE OVERLAND CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $150,000 by J. D. Hubbard, M. A. McCollum and G. Westervelt.

THE POSITIVE ELEVATOR COMPANY, of New York, N. Y., has been incorporated by August Koenig, of Orange, N. J.; Henry L. Murdock and Eugene R. Huckel, of New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture elevators, safety devices, etc.

THE POWELL MACHINE COMPANY, of Fitchburg, Mass., has been chartered for the purpose of manufacturing and selling machinery. The company is capitalized at $50,000 and the officers are: A. M. Powers, of Worcester, Mass., president, and M. A. Coolidge, of Fitchburg, Mass., treasurer.

THE RAE ELECTRIC VEHICLE COMPANY, of Springfield, Vt., has been organized for the purpose of building a new type of electric automobile. The company has acquired a site on the river for its works, and it is said that a good sized plant will be erected. H. K. Parkman, of Springfield, Vt., is interested in the project.

THE STANDARD CONNECTOR COMPANY, of White Plains, N. Y., has filed articles of incorporation with a capital stock of $30,000 for the purpose of doing electrical work. The incorporators are: S. L. Chamberlain, F. J. Danks, of New York, N. Y., and H. C. Chamberlain, of Yonkers, N. Y.

THE SYRACUSE GAS ENGINE COMPANY, of Syracuse, N. Y., has been chartered by F. C. Eddy, L. S. Chapman and E. J. Paradise, all of Syracuse, N. Y. The company proposes to manufacture gas, gasoline and other motors and engines, etc. The capital stock of the company is placed at $150,000.

THE VACUUM LAMP COMPANY, of Newark, N. J., has been incorporated by Jacob Wacchter, Hermann Schramm and Henry Pomerehne, all of Newark, N. J. The company is capitalized at $100,000 and proposes to manufacture vacuum electric lamps, bulbs and fixtures of all kinds.

THE WHEELER ROTARY ENGINE & POWER COMPANY, of Meriden, Conn., has been chartered with a capital stock of $200,000, by W. W. Wheeler, W. H. Way, G. E. Bicknell and Fred Rees, all of Meriden. The company proposes to manufacture an engine of new design, and is now building a demonstrating engine, designed to develop from 200 to 300 hp.

THE WILMINGTON BUILDING & CONSTRUCTION COMPANY, of Wilmington, Del., has been chartered with a capital stock of $50,000 for the purpose of doing a general contracting business. The incorporators are: William Alan Sands, William J. Highfield and George L. Townsend, all of Wilmington, Del.

THE WRIGHT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000,000 to manufacture machines, ships, etc., for aerial operation or navigation. The incorporators are: W. Wright, O. Wright, both of Dayton, Ohio; G. A. Steves, H. S. Hooker and A. F. Barnes, of New York, N. Y.

THE W. H. ZIMMERMAN COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 by E. O. Grassly, E. A. Campbell and W. H. Zimmerman. The company proposes to do a general engineering and contracting business.

New Incorporations.

GURLEY, ALA.—Articles of incorporation have been filed for the Gurley Light & Power Company with a capital stock of $10,000. The officers of the company are: Fred H. Howe, president and treasurer; Frank B. Gurley, vice-president, and G. A. Plummer, secretary.

PETALUMA, CAL.—Articles of incorporation have been filed for the Petaluma Rural Telephone Company with a capital stock of $50,000. The company proposes to construct and operate telephone lines extending from Petaluma to different sections in the county. The incorporators

are: D. M. Winans, T. G. King, George B. Robinson, S. L. Stice, E. P. Long and Frank Whitlach.

VISALIA, CAL.—Articles of incorporation have been filed for the Mt. Whitney Power & Electric Company with a capital stock of $5,000,000 and the following directors: John C. Hays, Thomas J. Broidrick, Fred G. Hamilton and Harry T. Hays, all of Visali, Cal., and Allen C. Chickering, of Oakland, Cal. A deed was filed with the county recorder transferring all of the property of the Mt. Whitney Power Company to the Mt. Whitney Power & Electric Company.

PLYMOUTH, ILL.—The Plymouth Mutual Telephone Company has been incorporated with a capital stock of $1,500 by B. L. Cloud, S. H. Aldridge and A. T. Bartell.

GREENFIELD, IND.—The Citizens Electric Company, of Hancock County, Indiana, has filed articles of incorporation with the Secretary of State, with a capital stock of $1,000. The company proposes to erect and operate transmission lines for the distribution of electricity for lamps, heat and motors throughout Hancock County. Elam M. Leary, John S. Thomas and R. F. Morgan, directors.

ONAGA, KAN.—The Onaga Light, Heat & Power Company has been organized with a capital stock of $6,500, and application will soon be made to the State Board for a charter. The company proposes to furnish electricity in Onaga. The directors are: Peter Gurtler, Peter Gaume, E. L. Frezeires, L. L. O'Meare and Hermann Tessendorf.

PORTLAND, MAINE.—The Ram Island Power Company has been organized for the purpose of furnishing electricity for lamps, heat and motors in Lewiston, Auburn, Minot, Greene, Turner, Leeds, Livermore, East Livermore and Jay. The company is capitalized at $100,000. The officers are: Roscoe T. Hoit, of Portland, president, and John H. Ridge, of Portland, treasurer.

ISLIP, N. Y.—The Islip Electric Light Company has been incorporated by William H. Moffitt, Frank Creamer and John H. Vail, all of Islip, N. Y. The company is capitalized at $20,000 and proposes to furnish electricity for lamps, heat and motors.

CINCINNATI, OHIO.—The Cincinnati, Harrison & Indianapolis Traction Company has been chartered with a capital stock of $10,000 by A. K. Nippert, Charles E. Roth and William L. Finch. The company proposes to construct an electric railway between Cincinnati and Harrison, which may ultimately be extended to Indianapolis, Ind. The old Westwood steam road will be used, but 14 miles of new construction will be required.

RAVIA, OKLA.—The Ravia Telephone Company has been chartered with a capital stock of $5,000 by J. B. Moseley, of Oklahoma City, Okla; J. R. Chitwood and Mrs. N. Chittwood, both of Ravia.

DARLINGTON, S. C.—A charter has been issued by the Secretary of State to the Darlington Water & Electric Company, capitalized at $50,000. The purpose of the company is to do a general power and lighting business. The officers are: A. P. Maloney, president; W. M. Haynesworth, vice-president, and L. C. Ritchie, secretary.

MARION, S. C.—The Marion Water & Light Company has been incorporated with capital stock of $50,000 to conduct a water and light business. The officers are: A. P. Maloney, president; P. A. Willcox, vice-president; J. S. Mitchell, secretary, and L. C. Ritchie, treasurer.

ROCK HILL, S. C.—The Rock Hill Water & Electric Company has been chartered with a capital stock of $100,000 to carry on a general power, light and water business. The officers are: A. P. Maloney, president; W. T. Fewell, vice-president; J. S. Mitchell, secretary, and L. C. Richtie, treasurer.

SALT LAKE CITY, UTAH.—The Castle Valley Railway Company has been incorporated for the purpose of constructing an electric railway from Price to Cedar Creek Canyon. W. C. Rice, of Salt Lake City, is president.

WASHINGTON HARBOR, WIS.—The Washington Island Telephone Company has been organized for the purpose of establishing a telephone service to reach all parts of the island. The officers are: John Goesselson, president; William Foss and B. Johnson, vice-presidents; William Jess, secretary, and George Mann, treasurer.

CHARLESTON, W. VA.—The Consolidated Telephone & Telegraph Company, of New York, N. Y., has filed articles of incorporation with the Secretary of State. The company is capitalized at $25,000 and proposes to operate lines in the United States and Canada. The incorporators are: S. H. Noyes, J. M. Ritz, A. B. Woodruff, J. H. Klieves and Edgar Charnosk, all of Wheeling, W. Va.

Personal.

MR. R. B. OWENS, formerly professor of electrical engineering at Magill University, Montreal, Can., has become associated with the Southern Power Company, Charlotte, N. C.

MR. L. C. KERRICK, formerly with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, has entered the sales department of the Electric Storage Battery Company, with headquarters in Boston.

MR. RALPH D. MERSHON, consulting engineer, of New York, has established a branch engineering office in the Street Railway Chambers, Montreal, Canada, Mr. Harry L. St. George being his Canadian representative.

MR. J. M. GEORGE has resigned his position as manager of the Southern Bell Telephone & Telegraph Company at Tifron, Ga., to accept the position as chief engineer for the municipal electric light and water works plant at Moultrie, Ga.

MR. J. J. WRIGHT, general manager of the Toronto Electric Light Company, Toronto, Canada, has been selected as honorary president of the company's section of the National Electric Light Association, which has been formed with a membership of 45.

MR. PATRICIO A. SUAREZ, a graduate of Manhattan College, New York City, the class of 1904, has been appointed administrator and director-general of the Compania Electrica de Alumbrado y Traccion de Santiago de Cuba, with offices at San Felix.

DR. R. T. GLAZEBROOK, who was a delegate to the Chicago International Electrical Congress in 1893, and the St. Louis International Electrical Congress in 1904, has been awarded the Hughes medal by the (British) Royal Society for his researches on electrical standards.

MR. D. F. FRADETTE, who has been connected with the sales departments of the West Penn Electric Company at Connellsville, Pa., and of the Des Moines Electric Company, Des Moines, Iowa, has been placed in charge of the contract department of the Merchants' Heat & Light Company, Indianapolis, Ind.

MR. J. B. KILMORE, formerly connected with the Scranton Electric Company, has been appointed manager of the Conshohocken (Pa.) Electric Light & Power Company. Both of these companies are owned by the American Gas & Electric Company, and Mr. Kilmore's promotion comes in recognition of good work done in the power department of the Scranton company.

MR. CHARLES ROBBINS, who has for many years been connected with the Westinghouse Electric & Manufacturing Company in the industrial and power sales department in connection with the sale of industrial motors, has recently been appointed manager of this department. Mr. Robbins has been with the company since 1899, in which time he has been in the manufacturing department, the New York district office sales department, and for the past three years in the industrial and power sales department at East Pittsburgh. His headquarters will continue to be at East Pittsburgh.

MR. S. L. NICHOLSON has recently been appointed general sales manager of the Westinghouse Electric & Manufacturing Company, and has direct charge over the sales policies of the entire company. Mr. Nicholson has been with the company for 11 years in many different capacities, as salesman, as district department manager, and as industrial and power sales manager for the past five years, from which last position he resigned to take the present post. Before coming to the Westinghouse Company he was with the C. & C. Electric Company. Mr. Nicholson organized and has been president of the American Association of Motor Manufacturers.

MR. SAMUEL A. CHASE, who for the past few years has been with the Westinghouse Electric & Manufacturing Company in its New York sales office as a special detail and supply salesman, has recently resigned to accept a position with the White Investing Company, of New York City, a financial investment company handling stock of many different organizations. Previous to Mr. Chase's employment with the Westinghouse Company he was a salesman for the Western Electric Company. Mr. Chase will, after Jan. 1, be in charge of the Chicago office of the White Investing Company, having exclusive territorial rights in North and South Dakota, Minneapolis, Iowa, Illinois and northern Indiana.

MR. G. BREWER GRIFFIN has recently been appointed manager and is actively directing the sales policy of the detail and supply sales department of the Westinghouse Electric & Manufacturing Company, in which department transformers, meters, fans, heating appliances, switches, switchboards, railway line material, etc., are sold. Mr. Griffin has been assistant manager of this sales department for six years past, having previously been connected with the sale of detail apparatus in the Boston office, altogether having been employed some seven years with the company. Previous to his connection with the Westinghouse Company, Mr. Griffin was with the Manhattan General Construction Company of New York as a special representative, finally opening an office for it in Boston.

Obituary.

MR. ROBERT M. VAN ARSDALE, proprietor of the *American Engineer and Railroad Journal*, died at his residence, 276 West Seventy-first Street, New York, on Nov. 23.

MRS. T. C. MARTIN.—We regret to announce the death of Mrs. T. C. Martin, which occurred Nov. 25, after an illness extending over several years accompanied by much suffering. The funeral services and interment were private.

MR. ALBERT V. PORTER, who is said to have drawn the plans for the first electric power house built in this country, died at his home in Brooklyn, Nov. 23, at the age of 53 years. He was born in Gloversville, N. Y. He was an architect by profession and was for many years the consulting architect for the New York City Railway Company.

MR. ALFRED BISSELL TALCOTT, who was identified with the building of the early telegraph lines in this country, died at his home in Washington, D. C., Nov. 22, at the age of 84 years. He was born near Glastonbury, Conn., and early in his business career became engaged in electrical work in New York. He took part in rebuilding the old telegraph lines between New York and Washington, and in 1859 was manager of a telegraph office in Washington. He was a newspaper correspondent during the Civil War and for many years afterward. He is said to have operated the first field telegraph line used.

MR. W. McLEA WALBANK, first vice-president of the Montreal Light, Heat & Power Company, died after an operation for purulent meningitis at the Montreal General Hospital on Nov. 28. Professionally, Mr. Walbank was widely known personally or by reputation throughout Canada. He graduated from McGill University in 1877, and after a successful career as a surveyor and architect, he had charge of the Lachine Rapids hydroelectric development, and when the Lachine Rapids Hydraulic & Land Company was amalgamated with the Montreal Light, Heat & Power Company, Mr. Walbank's services were secured as first vice-president, a post he held until his demise. Mr. Walbank was one of the founders of the Canadian Society of Civil Engineers, of which Institution he was president in 1907. He was a member of the Engineers' Club, serving as vice-president of that body in 1904. He is survived by a wife and three sons.

MR. JOHN CALDWELL, treasurer of the Westinghouse Air Brake Company, was stricken with heart disease on Nov. 23 and died in his office before a physician could reach him. Mr. Caldwell was born in the north of Ireland about 70 years ago, his father being a Presbyterian minister. He came to Pittsburgh as a lad of 12, and his first employment was as a clerk in a grocery store. For several years he followed mercantile pursuits, and upon the organization of the Westinghouse Air Brake Company in 1869 he became its bookkeeper, a position he retained for 10 years. He was then elected treasurer, a position he held for the rest of his life. When the Westinghouse Electric & Manufacturing Company was organized Mr. Caldwell was made treasurer of that. He retained the position until the organization was put on a smooth running basis, when he resigned in 1892 to give his entire time to the air brake company. This was also true of the Philadelphia company, to which he was also elected treasurer when this company was organized, resigning in 1899. At the outbreak of the Civil War he was enlisted as a private in Company E, Sixty-first Pennsylvania Volunteers, and was mustered out as a second lieutenant at the close of the war. He was wounded at the battle of Spottsylvania. Outside of his business affiliations, Mr. Caldwell had a world-wide reputation as an art connoisseur and collector of rare books. His collections at his Edgewood home are said to be among the most valuable in existence. He was particularly fond of etchings, and his collection of Whistlers is said to be unequaled. His books have been gathered from all parts of the world and are reputed to be priceless. At his death Mr. Caldwell was chairman of the fine arts committee of the Carnegie Institute trustees and also of the finance committee. He had an appointment to meet with the fine arts committee at Director J. W. Beatty's office on the afternoon of his death.

Trade Publications.

METAL MOLDINGS.—The Fancleve Specialty Company, Jamaica Plain, Mass., has issued a bulletin relating to fittings for metal moldings, including outlet plates, junction boxes and regular and angle-pattern boxes.

SERVICE SWITCHES.—The Central Electric Company, Chicago, Ill., is distributing two new circulars descriptive of D. & W. service switches, fuses and cutouts. These bulletins will be of considerable value to central station managers in that they give information on several new devices for use on highly inductive circuits such as offered by power loads.

PITTSBURGH TRANSFORMERS.—The Central Electric Company, Chicago, Ill., is distributing a new circular descriptive of the Pittsburgh transformer and illustrating various types from 0.6 kw to 1000 kw capacity. This circular shows the various methods of winding employed and calls particular attention to the new type of porcelain bushings and insulation used on the primary leads.

SWITCHBOARD INSTRUMENTS.—Bulletin No. 4700, issued by the General Electric Company, is devoted to a description of voltmeters and ammeters for use on alternating and direct-current switchboards. The features of the instruments are large window openings, wide pointers and legible scales. The ammeters are made in ratings up to and including 200 amp; the voltmeters for e.m.f. up to and including 750 volts.

Business Notes.

THE CROWN WOVEN WIRE BRUSH COMPANY, Salem, Mass., manufacturer of alloy and phosphor bronze brushes, has recently increased its plant to care for a steady growth in business.

MR. WILLIAM S. TAUSSIG, who is a dealer in electrical equipment and also secretary of the Electric Club of Chicago, has removed his office from 448 Commercial National Bank Building to 627 West Jackson Boulevard, Chicago.

THE HOSKINS MANUFACTURING COMPANY, of Detroit, has opened a branch office and exhibition room at 321 Dearborn Street, Chicago, in charge of Mr. W. B. Young. A complete line of the company's electric furnaces is shown in operation.

THE CROCKER-WHEELER MANUFACTURING COMPANY has decided to locate its Canadian works at St. Catherines, Ont., Can. The company has recently secured several large orders for machinery to be used in connection with power developments in Canada.

EDWARD E. CARY COMPANY, Inc., 59-61 Park Place, New York, reports that several large arc lamp makers are testing its "Prima" enameled steel casings for arc lamps. The casings are new in this country, though largely used in England and on the Continent.

HABIRSHAW WIRE COMPANY.—Mr. J. B. Olson, general sales manager of the Habirshaw Wire Company, has recently returned from an extended trip to the West. Among the contracts closed for Habirshaw wire were the Mechanics' Institute, Cincinnati; the New Sherman House, Chicago, and the City Bank Building, Omaha.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY reports that the past two weeks are the banner ones of the entire year in the sale of its Model E direct-current watt-hour meters. The sales include a number of its new astatic switchboard meters with removable armature, as well as many of its new portable test meters with fly-back pointers.

ELECTRIC STORAGE BATTERY SOUTHERN OFFICE.—The Electric Storage Battery Company announces a change in management of its Southern sales office. Mr. H. H. Seaman, the former manager, having resigned, Mr. A. N. Bentley has been appointed to take charge of this office. Mr. Bentley has had a comprehensive storage battery experience as the engineer of the company's Cleveland office.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Chicago Electrical Show, Jan. 15 to 29, 1910. Manager, Homer E. Niesz, 115 Dearborn St., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRIC CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chabbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Fred. Leslie, Muncie, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Walter J. Sittig, 61 Ward St., Chicago.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis. Next meeting, Chicago, Dec. 7, 8 and 9, 1909.

IOWA ELECTRIC ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, 1910.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, 1910.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 14-26, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

SAN FRANCISCO ELECTRICAL SHOW, Jan. 29 to Feb. 5, 1910. E. M. Scribner, Chairman.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary G. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV 23, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

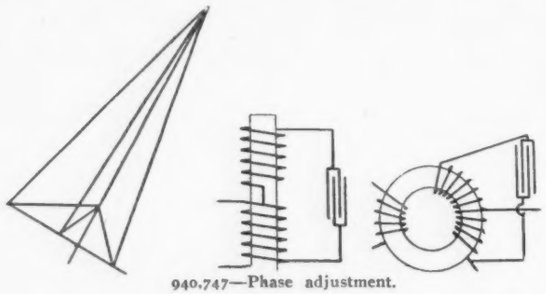
940,718. SELF-RESTORING TROLLEY; H. H. Parker, Cleveland, O. App. filed Nov. 23, 1908. A solenoid magnet shifts the pole vertically and laterally and a special trolley pole with contact arm is provided so that the contacts strike the wire when the wheel leaves it, which closes the circuit through the magnet to restore the pole.

940,734. ELECTROLYTE FOR USE IN ELECTRIC BATTERIES; W. J. L. Sandy, London, Eng. App. filed Aug. 22, 1908. A mixture of sulphuric and hydrochloric acids, water, bichromate of sodium and caustic soda.

940,736. VAPOR ELECTRICAL APPARATUS; H. M. Schiebe, Wilkinsburg, Pa. App. filed Jan. 21, 1909. For automatically starting vapor rectifiers by means of a tilting magnet having an actuating coil and an opposing coil which is effective when the apparatus is tilted.

940,742. WATER RETAINING AND CONVEYING ATTACHMENT FOR CABLE LIGHTNING RODS; H. Simpson, Burlington, Wis. App. filed July 6, 1908. A cable rod with a tubular grounding device, the latter being arranged to collect water so as to improve the ground.

940,747. PHASE ADJUSTMENT; W. E. Sumpner, Moseley, England. App. filed Dec. 4, 1907. For rectifying the phase error in watt



940,747—Phase adjustment.

meters, by means of an auxiliary winding having the same magnetic circuit as the ordinary winding and a condenser in said circuit of the auxiliary winding, the capacity of the condenser and the number of coils of the auxiliary corresponding substantially to the total amount of magnetization required in the core.

940,774. APPARATUS FOR TREATING MOLTEN METALS; F. S. Adams, Leetonia, Ohio. App. filed July 22, 1909. For treating molten metal for eliminating the sulphur by means of a metal pot with means for creating a vacuum, a pair of electrodes therein and electric magnetic solenoids for raising or lowering the electrodes.

940,787. RAILWAY SIGNALING APPARATUS; W. J. Cook, Denver, Col. App. filed Aug. 17, 1908. Means for lighting a lamp ahead of the train which is automatically extinguished after the train passes the lamp by means of track make-and-break devices.

940,800. RAILROAD SIGNAL; L. E. Garnett, Chanute, Kan. App. filed Aug. 14, 1908. For preventing rear end collisions by setting a signal automatically to danger and holding it there for a certain length of time so that the next train will be held until the danger signal is released.

940,821. PROCESS FOR TREATING ORES; J. R. Parks, Spokane, Wash. App. filed Nov. 23, 1906. For reducing precious metal ores by mixing cyanide of potassium and an electrolyte and simultaneously passing a current of air and of electricity through the mixture.

940,831. ASEPTIC LAMP FOR DENTAL, MEDICAL OR SURGICAL PURPOSES; D. Stern, Cincinnati, Ohio. App. filed June 1, 1909. Can be placed in the mouth and consists of a miniature lamp encased in a glass globe.

940,881. AUTOMATIC CIRCUIT BREAKER; W. H. Lawrence and P. Torchio, New York, N. Y. App. filed Feb. 9, 1909. For selective and automatic operation of circuit breakers on alternating-current generators operating in parallel by means of an external reactance coil in each lead and overload relay calibrated to operate at a current in excess of the maximum instantaneous short-circuit current of each generator and its external reactance coil.

940,910. SAFETY ELECTRICAL CIRCUIT BREAKER; W. F. Wocher and L. F. Mortsolf, Indianapolis, Ind. App. filed April 25, 1908. For automobiles so that the owner may leave the machine. Consists in automatic key locking device and an inaccessible grounded wire which is connected automatically when the normal circuit is broken.

940,927. PROCESS OF MAKING SALTS OF AMMONIA, ESPECIALLY SULPHATE OF AMMONIA; O. P. Hurford, Chicago, Ill. App. filed Dec. 12, 1908. Causes the chemical union of nitrogen and hydrogen gas under the influence of electrical discharges in the presence of a suitable acid which combines with the ammonia as soon as it is formed to hold the same by forming a compound of ammonia.

941,002. SAFETY ELECTRICAL CIRCUIT BREAKER; W. F. Wocher, R. E. Lemon and L. H. Mortsolf, Indianapolis, Ind. App. filed Nov. 30, 1908. For permitting the owner of an automobile to leave his machine. A circuit breaker including a locking bolt which when locked grounds an electric circuit and an improved flexible connection between the circuit breaking casing and the ground so as to defeat attempts to restore the circuits.

941,020. FUSE; F. G. Jones, Muskegon, Mich. App. filed March 11, 1908. A porcelain fuse wire support carrying conducting caps terminals within which a tortuous channel is provided for the fuse.

941,039. CABLE HANGER; C. L. Pierce, Jr., Chicago, Ill. App. filed Sept. 13, 1908. A messenger straddling member of sheet metal and U-shaped, together with a pliant suspending cable.

941,113. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 13, 1909. A main source of electrical energy supplies a consumption current. A storage battery and booster maintain the load on the main circuit substantially constant, the booster having a single armature core structure with brushes for feeding current to the armature for driving the dynamo and brushes for taking off current and field windings for compensating for armature reaction.

941,144. SIGNAL; L. A. Hawkins, Schenectady, N. Y. App. filed Dec. 29, 1908. For controlling a plurality of cars which are admitted into a block, each car being counted by the signal mechanism, the signals not being cleared until the last car has left the block. Uses a differential gear, a signal controlled by one member thereof, a pair of electromagnets, and connections between the other two members of the gear and the magnets.

941,151. THIRD-RAIL ELECTRIC RAILWAY SYSTEM; C. Kozesnik, New York, N. Y. App. filed April 18, 1908. Contact shoe carrying an electromagnet movably mounted therein and carrying a roller adapted to bear against the surface of the rail.

941,156. RECEPTACLE OR THE LIKE FOR CONDUITS; G. A. Lutz, Plainfield, N. J., and C. C. Sibley, Perth Amboy, N. J. App. filed March 5, 1908. A fitting on a conduit having a locking piece with independently movable portions to engage opposite sides of conduit.

941,165. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 18, 1909. For enclosing fuses for circuit connections in porcelain. Uses a removable circuit closing plug entering between a fuse support and a circuit terminal.

941,174. INCANDESCENT LAMP SOCKET; F. W. Slady, Bridgeport, Conn. App. filed May 24, 1909. A pole socket having upper and lower insulating buttons, a rotary insulating block, a switch operating mechanism and a spindle of insulating material on which the oscillating member of a ratchet is mounted.

941,180. BRIDGING BLOCK FOR DYNAMO ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed June 2, 1909. A dynamo electric machine with coil containing slots, windings therein and elongated slot closing bridging blocks, each having a forked end.

941,181. LINING FOR SLOTS OF DYNAMO ELECTRIC MACHINE ELEMENTS; F. W. Young, East Orange, N. J., and Edward Heitmann, Montclair, N. J. App. filed June 5, 1909. An armature with coil containing slots, windings therein and slot closing bridging blocks of magnetic material in the slots with insulated metallic windings between the slots and the blocks.

941,182. BRIDGING BLOCK FOR DYNAMO ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed July 19, 1909. A slot closing bridging block consisting of a sheet metal trough and an iron core cast therein.

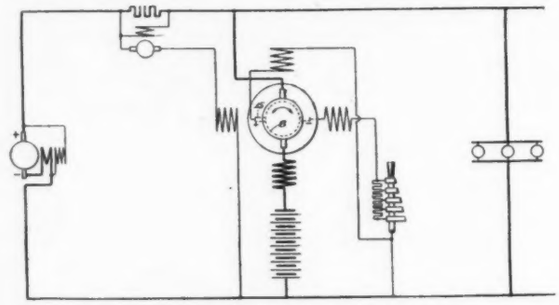
941,211. APPARATUS FOR PRODUCING AUDIBLE MOVING PICTURES, PIECES OF MUSIC, AND OTHER PERFORMANCES; Franz E. Thormeyer, Hamburg, Germany. App. filed March 1, 1909. Apparatus for synchronous working which does away with driving by hand by using a third driving device with an indicator.

941,215 WATER HEATER; G. H. Wade, Atlanta, Ga. App. filed Sept. 2, 1908. A heater having casing with a spiral groove terminating at the center and periphery through which the water passes.

941,216. TROLLEY POLE CATCHER; J. E. Walker, Lexington, Ky. App. filed Dec. 4, 1908. A trolley pole catcher having a rack and carrier frame with a dog carried by the frame engaging the rack and a brake.

941,233. AUTOMATIC SAFETY APPLIANCE FOR RAILWAYS; W. G. Daring, Pittsburgh, Pa. App. filed April 27, 1909. Normally open circuits with a contact block and an equipment on the train having an electrically released valve for releasing the air to set brakes.

941,259. COMBINED SIGNAL AND AIR BRAKE; A. M. Jones.



941,113—Electrical System of Distribution.

Hagerstown, Md. App. filed Feb. 10, 1909. A whistle, a reservoir and train pipe, and a spring actuated track device for actuating the parts.

941,263. RAILWAY SIGNALING SYSTEM; T. MacDougal and James McKinnon, Boulder, Col. App. filed June 16, 1908. Includes a circuit closer, an electromagnet, an indicator associated with the armature of the magnet so as to display a signal and non-electric means to retract the signal.

941,266. ELECTRIC SWITCH; W. W. Morse, Westport, N. Y. App. filed Dec. 28, 1908. For controlling water power plants at a distance by means of a switch lever operated by a solenoid.

941,276. ELECTRICAL RECEPTACLE; F. J. Russell, New York, N. Y. App. filed Sept. 25, 1908. For receiving electrical connecting plugs or lamp bases, the body having a plug receiving socket and a wire plug holder having a single spiral holding loop.

941,332. RAIL FASTENER AND BOND; C. D. McAfee, Burgettstown, Pa. App. filed March 12, 1909. For rail bonds having splice bars bracing the rails, bolts extending through them. Details.

941,339. PROCESS OF PRODUCING SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed June 14, 1907. Embeds in a charge of silicons and carbonaceous materials a resistance conductor made up of a series of pieces longitudinally in direct electrical contact and arranged in a circuitous line between the terminals.

941,342. ELECTRICAL SAD IRON; W. A. Braun, Fort Wayne, Ind. App. filed Jan. 20, 1908. Automatic apparatus for breaking the circuit when the iron becomes heated, by means of an expanding member controlling the circuit breaker.